THE

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ELECTRICAL REVIEW.

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THE

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THE BRITISH ASSOCIATION AT LEICESTER.

WRITING in anticipation of the opening meeting, there is little to be said in general regarding the session of 1907, save that, to electrical men, it appears likely that the proceedings will be of less interest than usual. This is not, indeed, surprising, for ever since the days when the B.A. exercised a powerful and unique influence in the electrical world, the multiplication and growth of technical associations and rival institutions has tended to detract from its importance, and by anticipation to discount the novelty of the matters dealt with by it.

Nevertheless, the Association has a place and value of its own, which can be filled by no other institution. It affords an opportunity for the reunion of old friends amid agreeable surroundings, combined with pleasant excursions to places of interest; a means of imparting to a wide circle a *résumé* of the latest advances in science in all directions; and a kind of stage or halfway house between successive years, where one may pause and survey the ground that has been traversed, appraise the difficulties of the tasks about to be commenced, and deliberate upon the programme for the coming year.

In his Presidential address to the Engineering Section, Prof. Silvanus P. Thompson, after an appropriate reference to the lamented death of Sir Benjamin Baker, utilised the occasion somewhat in the way we have described. The President touched upon the vast development of the material resources of civilisation, the rapidity of its progress, and the absolute dependence of the whole upon science, directed mainly by the engineer. "Without the engineer how little of all this activity could there have been; and without mathematics, mechanics, physics, and chemistry, where were the engineer?" The immense differences between social and industrial conditions obtaining in England in the respective reigns of Edward the Sixth and Edward the Seventh (long may he reign!) are almost wholly due to science and its applications.

On the other hand, the industrial development of useful inventions, the fruit of scientific discovery, has had an enormous influence upon the progress of pure science. The invention of the steam engine gave rise to the new science of thermodynamics, and the industrial application of the electric telegraph led to the development of electrical theory by leaps and bounds. Science and practice ever walk hand in hand.

Turning more especially to the interaction of science and industry in connection with the development of electric motive power, Prof. Thompson traced the history of the subject from the discoveries of Oersted and Faraday, nearly a century ago, down to the present day. Sturgeon's invention of the soft-iron electromagnet really laid the foundation of electrical engineering, for without it nothing

of-moment could have been accomplished. Even in 1857, though much attention had been given to the subject, electric motive power was declared to be impossible, and the counter electromotive force of electromagnetic machines, upon which the development of power depends, was looked upon as a detrimental phenomenon!

Of the great men of that day, only one—Lord Kelvin—has been privileged to survive and to witness the astonishing developments of the past half-century. Now electric motors of all sizes, from one-twentieth of a horse-power up to 8,000 H.P., are fairly established in commercial use, and Prof. Thompson showed how their evolution had been accomplished by the action and reaction of pure and applied science, leading to triumph after triumph. "The history of the electric motor is probably without parallel in the lessons it affords of the commercial and industrial importance of science."

Passing from his masterly study of the interaction of pure and applied science to its bearing upon the education and training of engineers, the President emphasised the necessity of applying similar principles to the development of the individual engineer, who must add knowledge to experience in order to meet the organised competition of the trained men of other nations. Especially in the teaching of mathematics must the practical application of the science be kept in view. In this we most cordially agree. We have repeatedly met with men who had been taught by a most able mathematician, but to whom the simplest practical problems in dynamics were absolute stumbling-blocks, and who, after calculating the mass of a fly-wheel, for instance, were unable to decide whether their results were expressed in pounds or poundals! "When the student loses grip of the physical meaning of his equations, and regards them only as abstractions or groupings of symbols, woe betide him. His mathematics amount to a mere symbol-juggling. That is how paper engineers are made. The high and dry mathematical master who . . . . never culls an example or sets a problem from thermo-dynamics or electricity, must be left severely on one side as a fossil."

May we here put in a word of praise for the splendid work that has been done, and is being done, by Prof. Thompson's former colleague at Finsbury—Prof. John Perry? We are confident that no man living has done more to urge on the much needed reform in the teaching of engineering mathematics than he—would that every technical college in the kingdom possessed his like!

Rightly condemning the practice of taking premium pupils into works without previous training, a parasitic system which, in its time, has been the disgrace of English engineering works, but happily is dying of the poison which itself engendered, Prof. Thompson commented with approval upon the excellent systems of apprenticeship which have been introduced by such firms as Yarrow, Siemens and others, and recalled the authoritative pronouncements of the Committee which reported to the Engineering Institutions on the subject last year. He expressed wonder that the Board of Education had not yet carried out the recommendation to establish a "leaving examination" for secondary schools throughout the United Kingdom, and described the scheme of education and training recommended by the Committee as genuinely scientific, and calculated "to secure to every future engineer worthy of the name the advantage of learning his professional work in both its aspects." It remains for the employers to make use of the training institutions, and "to show that sympathetic interest in their efficiency which is essential to their full success."

Effect of Top-Deck Covers on Stability.

At the time when covered top-decks threatened to become common, there were apprehensions in several quarters regarding the safety of cars with so much added top weight and wind area, and the B. of T. showed their anxiety by practically forbidding the addition of covers to narrow-gauge cars, although at that time we knew of tramways having a gauge of 3 ft. 6 in. upon which completely enclosed single-truck double-deck cars had been running for at least 12 months, and had travelled right side up through gales, during which the velocity of the wind exceeded 60 M.P.H., and was said to have reached 80 M.P.H., velocities equivalent to pressures between 17 lb. and 32 lb. per sq. ft. We remarked at the time of the B. of T. scare that top-deck covers were in general use on steam tramcars long before electric cars were thought of; yet the cars were not blown over, although their centre of gravity was higher than that of a self-contained electric car with heavy machinery near the ground.

No one who had fitted covers to narrow-gauge cars was sufficiently frightened by the B. of T. to remove them, but there was one undertaking at least which went into the matter with care, only to find that it was impossible for their covered cars to stand up against the gales to which they had been subjected already. As careful people should do, they spread the risk by building more covers, and the result has justified the expenditure, for no accident has happened yet.

It is obvious that a car with a top cover will reach the line of instability sooner than a similar car carrying the same number of passengers but having an open top; but from previous experience and from an article which recently appeared in the *Tramway and Railway World*, it is obvious also that a car is more stable in practice than in theory. Nevertheless, the article is well worth reading by those who have not troubled to go through the same calculations for themselves, and, whether or not the conclusions are as true in fact as they are in figure, they are likely to be correct in relation to each other; in other words, the comparative stability of covered and open cars can be judged. The calculations are concerned with standard as well as with 3 ft. 6 in. gauge, but no one has been nervous about the former from the point of wind pressure. The last table shows that an unloaded covered car must overturn before the velocity of the wind reaches 60 M.P.H., and when loaded inside about 2½ lb. per sq. foot more is all that is necessary to produce a calamity. With such figures in his mind, no man should be called over-cautious who sends in all covered cars when a full gale is blowing, if only because the combination of wind pressure and centrifugal force at some curve might prove disastrous.

Probably the discrepancy between theory and experience in all matters relating to the stability of tramcars is due in some measure to the practice of regarding the truck as springless, and as being connected rigidly to the body, whereas, in fact, the complete structure under wind stress is more like a bending tree.

The danger from centrifugal force at curves is much more real than that due to wind pressure, especially as super-elevation can rarely be given, and actual depression of the outer rail is often seen. Under the best circumstances the speed around such sharp curves as 40 ft. radius should be rigorously limited to 6 or 8 M.P.H., and to 4 or 6 M.P.H. when top covers are used. As we never hear of cars overturning at curves unless they have got beyond the driver's control and have reached a high speed on a down grade, we may suppose that, as a general rule, drivers take sharp curves at speeds well below the danger point, and so many covers are now fitted to narrow-gauge cars that there is little probability of further interference by the Board of Trade.

Economic Size of Pipe.

In a paper read before the American Society of Civil Engineers last month, Mr. A. L. Adams (member) discussed the problem of designing the pipe for a water-power installation, so as to secure the most economical results. As shown by Lord Kelvin for electrical conductors, there must be a size of pipe for which the annual cost of energy lost in friction

plus the annual cost of the pipe line is a minimum. Mr. Adams states a proposition somewhat confusedly thus:—"That the relation between the investment in any pipe line and the value of the energy lost in frictional resistance to flow is most economical, wherein the cost of the pipe plus the value of the energy sacrificed is a minimum. Or, if one chooses to state it in terms of the annual cost: Wherein the annual cost of the pipe line plus the value of the energy annually sacrificed is a minimum." These statements are by no means equivalent, the former, indeed, involving the addition of capital to revenue charges. The author, however, proceeds to work out the problem on the basis of the first of these, his method being the eminently practical if laborious one of working out a series of examples for a set of given conditions, and presenting the results in the form of curves.

Unfortunately his conclusions are wholly vitiated by the fact that the curves only show the relation between the value of the energy lost (per annum, we presume, though this is not stated, and apparently at full load continuously) and the cost of the pipe line in place, and the author deduces an extraordinary rule by an intellectual *tour de force* which passes understanding. It is to be hoped that those who read his remarkable paper will be able properly to appraise the value of his well-intentioned but mistaken efforts.

The problem is really on all fours with that first investigated by Lord Kelvin, whose law is unkindly cited by Mr. Adams as that of "Sir William Thomas," and is in addition misquoted. Reasoning by analogy, the most economical size of pipe is that which makes the annual value of the energy lost in friction, &c., equal to the annual charges on that part of the capital expenditure which varies with the size of pipe. In working out the size on this basis, of course, due account should be taken of variations of load throughout the day and year, and as in general the conditions cannot be accurately foreseen, the result can only be a rough approximation; however, the rule may be useful as a check on other methods, and as an antidote to such misleading statements as that of Mr. Adams.

Electricity in the Foundry.

In a recent issue of *Cassier's Magazine*, Mr. H. S. Knowlton discusses the applications of electricity in foundry work, and gives illustrations of motor drives in several large foundries.

It is, perhaps, claiming a great deal to say that the general conditions of foundry work are improved by the introduction of electrical driving, as a clean foundry is almost unthinkable. The author, however, points out that an electric motor performs its work without introducing escaping steam, smoke, dirt, excessive heat or other troublesome additions into the already over-burdened atmosphere, and the extent to which these objections are eliminated may be credited to the electrical drive. As it is difficult to secure any kind of ventilation in a foundry, enclosed motors are, in the author's opinion, an absolute necessity when direct-current machines are used. For constant-speed work the induction motor is far ahead of the direct-current machine, but dust-tight bearings should be provided. The author further points out that it would be impossible to maintain the present rates of production without electric travelling cranes in the foundry, as the cost of transport forms such a large item in the total costs. The variety of uses to which motors can be put in foundry practice is greater than might at first be supposed. The following are some of them:—Travelling cranes, lifting magnets, transporters, furnace charging, blowers, magnetic separator, emery grinders and tools generally. As regards the lighting problem, this is one of considerable difficulty, as practically every form of enclosed lamp becomes coated over with dirt so quickly as to be of very little use. The open-type arc appears to be the best for the purpose. Gas and oil, Mr. Knowlton maintains, cannot compare favourably under any circumstances with electric light in the foundry.

The Future of "Suction Gas."

While it is a comparatively easy matter to deal with the history and the present position of this latest innovation in power generation, the question of its future development requires very careful treatment, unless the prophet wishes to be classed with those who have attempted to forecast the end of the world, or to-morrow's weather.

The practical application of producers for gasifying fuel for heating purposes dates back to between 60 and 70 years ago, but the employment of the gas formed by the partial combustion of fuel with air and steam in its various modifications, for the direct development of power in the cylinder of an internal combustion engine, was not attempted on a commercial scale until much later.

It is, in fact, only about 17 years since the employment of producer gas in large power gas engines permitted of the serious commencement of the competition of the gas engine with the steam engine, except under special conditions, but previous to this, smaller installations were in use of about 100 H.P. and up to 250 H.P., working on the Dowson "pressure" system, and similar types of producers employing non-bituminous fuel; these plants, requiring a gas holder and steam boiler, were generally too high in initial cost to permit of their being employed for small power requirements. The suction gas producer, however, needing no gas holder or auxiliary boiler, at once entered the field for powers ranging from 4 B.H.P. upwards; but still the fuel most suitable is of the non-bituminous class, and is more expensive than common slack coal. Even if the suction principle can be applied successfully to gasify the cheapest class of bituminous coal, present indications go to show that the purifying apparatus necessary will form a serious item in first cost and labour for attendance.

It will be evident, therefore, that the cost of available fuel and its physical properties will have considerable control over the future applications of the suction-gas producer system; for while with non-bituminous or slightly bituminous fuels the principle can be applied to plants of 3,000 H.P., where cheap anthracite or coke can be obtained, if it is desired to make use of bituminous coal for such large powers, the value of the by-products becomes of sufficient importance to warrant their recovery.

The recovery of the by-products, of which ammonia is the most valuable, necessitates the employment of apparatus not suitable for association with the direct suction method. For installations ranging above 3,000 H.P., it is most probable that the Mond system, or some modification of it, will be employed, limiting the application of the suction principle, in its present forms, to powers below that given, because, though the profit to be derived from the by-products is considerable, it can only be realised by an initial outlay for the apparatus necessary that can only be borne by a large power installation.

It is possible that improvements in ammonia recovery plant may be effected which will bring the limit of application below 3,000 H.P., but owing to the cost of non- or semi-bituminous fuel, it is hardly within the range of the suction producer to compete successfully with the bituminous producer for large installations for the reasons quoted.

It is a significant fact, that although there are a large number of firms advertising suction gas plants, they generally do not include in their lists of standard sizes plants *above* 150 to 200 H.P.; the lower limit is in the neighbourhood of quite small powers of 4 to 6 I.H.P.

Power for power the suction plant costs more to install than a steam installation, but it has many advantages, besides the reduction in the cost of fuel. However, the gas engine application involves the arrangement of load conditions, &c., so different from that of its rival that in several instances want of this knowledge has resulted in failure to give satisfactory results, and it is pretty well agreed that those brought up to the use of steam are not qualified to make a success of a gas plant, owing to the changed conditions involved by the employment of the internal combustion engine, especiall when it is of the Otto or four-cycle type.

THE ELECTRIFICATION OF THE HAMMERSMITH AND CITY SECTION OF THE GREAT WESTERN RAILWAY.

THIS extensive scheme of electrification carried out by the Great Western Railway Co., with a view to the homogeneous operation of the London lines owned jointly by it and the Metropolitan Co., and for other local purposes, was described at considerable length in the ELECTRICAL REVIEW of June 22nd and July 6th, 1906; we are enabled, however, through the courtesy of Messrs. Kennedy & Jenkin, the consulting engineers to the Great Western Railway Co. for this work, to give some further description and to illustrate some of the more interesting details of the scheme on the present occasion.

The extent of the line which has been electrified, and for which power is supplied by the Great Western Co., is shown on the accompanying plan, fig. 1. It includes the Hammersmith and City line proper, with its branch line from Latimer Road to Uxbridge Road, and the Great Western additional lines between Bishop's Road and Westbourne Park. From Uxbridge Road to Addison Road the trains run over the West London line, a portion of which has, in consequence, had to be electrified, together with two bays at Addison Road station. The new scheme also provides for the supply of energy for arc and incandescent lighting and small motor work throughout the Great Western Co.'s system in the London district, as well as on the Hammersmith and City Railway.

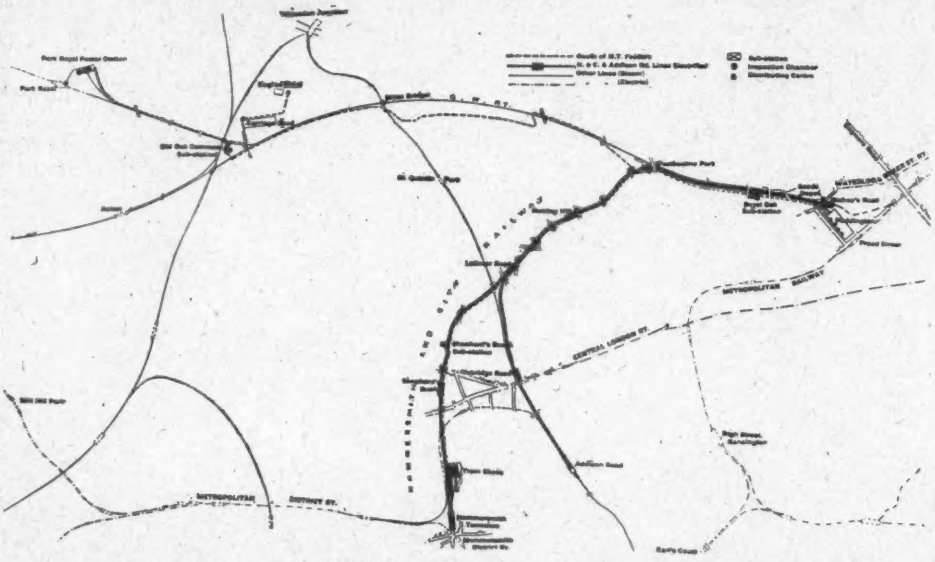


FIG. 1.—PLAN SHOWING THE ELECTRIFIED ROUTES OF THE GREAT WESTERN RAILWAY CO., &c.

A generating station situated at Park Royal; three sub-stations situated at Old Oak Common, Royal Oak and Shepherd's Bush, at distances of 1, 4½ and 5 miles respectively from Park Royal; and 11 distributing centres situated at convenient points on the route, are included in the scheme.

Electrical energy is generated as three-phase A.C., at a pressure of from 6,300 to 6,600 volts and 50 cycles, and transmitted at this pressure to the three sub-stations, where the greater part is converted by motor converters to D.C. at 600 volts pressure for traction purposes, but a supply at 600 volts is also distributed for sundry power purposes, and arc lighting to the Great Western Co.'s locomotive and carriage sheds, goods yards and offices, and Paddington Station. A three-phase, 6,500-volt A.C. supply is also distributed from the sub-stations to the distributing centres, where it is transformed down by static transformers to either 220 or 110 volts pressure for arc and incandescent lighting and small motor work in the above-mentioned departments, including hotel and station premises at Paddington, and on the Hammersmith and City Railway.

The Power Station.—This occupies about one-sixth of the ground available, and is designed so that five other similar installations may be put down as required. The main building is a steel-framed structure, filled in with brickwork, and includes a boiler house consisting of three bays, with an engine house at one end, also consisting of three bays, and at the other end an extensive coal-handling plant.

The latter, which we shall describe in the first instance, is of a comprehensive character; its general outline being shown in fig. 3. Fuel is carried to the plant in a special train of 20-ton steel-hopper wagons, through the bottoms of which it is discharged into underground ferro-concrete coal silos, having a total storage capacity of 400 tons.

From the mouth-pieces in the bottom of the silos, coal is delivered on to two tray conveyors, which feed it into the boots of two bucket elevators; the latter, in turn, raise the coal to a height of 50 ft. above the boiler house floor level, and feed it on to two bucket conveyors, for transmission to the boiler house. Overflow shoots are provided through which coal is returned to the silos in the event of the elevators being kept running while the bucket conveyors are stopped.

The latter conveyors are carried by means of an overhead gantry as far as the east wall of the boiler house, and pass up the inside of this wall, over steel coal bunkers, and back through the basement, where ashes are fed into them by means of two travelling fillers provided with snouts which fit on to the boiler ash shoots.

In returning, the conveyors discharge the ashes into steel hoppers placed over a separate railway siding, an ash-quenching water spray being provided. The whole of the coal conveyor and elevator plant is arranged so as to be in duplicate, and the normal carrying capacity of each set is 50 tons of coal per hour, when also dealing with the ashes.

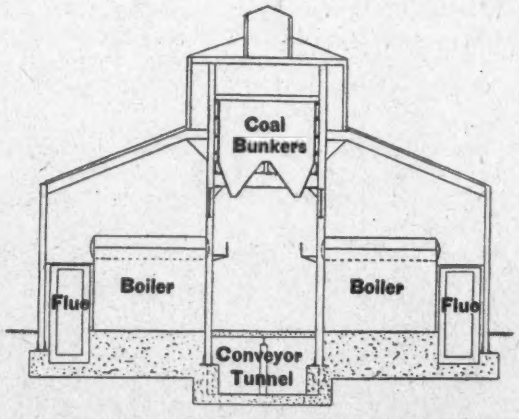


FIG. 2.—CROSS-SECTION THROUGH BOILER HOUSE, PARK ROYAL STATION.

The driving gear is situated at the end of the gantry over the silos, and a Denison automatic integrating weigher is fitted in the run of each bucket conveyor, just on that side of the driving gear where the chain is slack.

Each bucket conveyor is driven through worm gear by a 650-volt three-phase 10-B.H.P. motor, while the tray conveyor and bucket elevator corresponding to each bucket conveyor are driven through worm gearing by a single

650-volt three-phase 12 B.H.P. motor. These motors are of the E.C.C.'s patent type, the rotor having two windings and the starting up being normally effected by a special starting switch.

It may here be stated that the same type of motor is used for driving the condenser pumps, the stokers, the drainage sump pumps and two centrifugal pumps, used in connection with the water supply and drainage water.

Water is normally supplied from a local canal, but an alternative public supply is laid on to a storage tank. From this tank it passes to the pump room basement in the boiler house, where it is forced, by a centrifugal pump, through two Royle drain-water coolers into an overhead feed tank. From the latter the hot well make-up is drawn, being treated in softening plant before entering the hot well tanks.

Four Hall vertical feed pumps, each having a capacity of

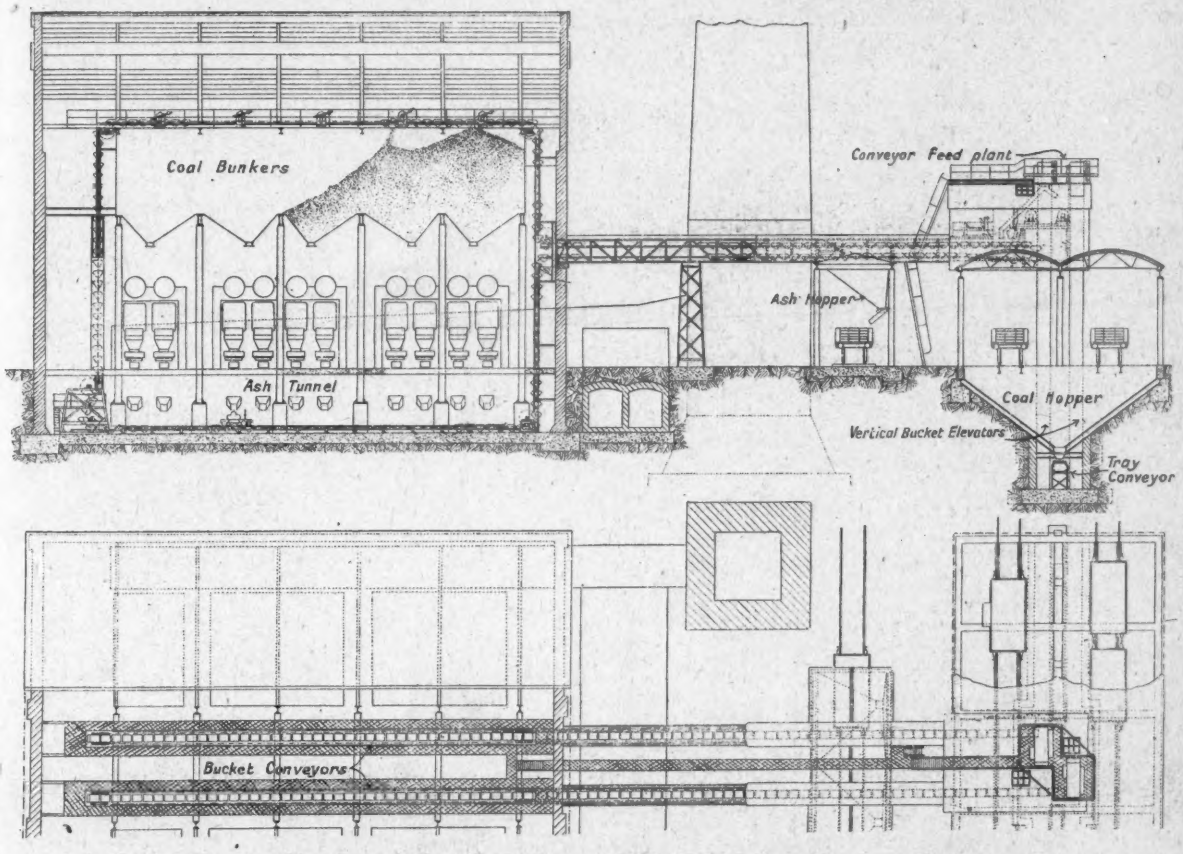


FIG. 3.—PLAN AND ELEVATION OF COAL HANDLING AND STORAGE PLANT, PARK ROYAL GENERATING STATION.

Provision is made for stopping the conveyors from various points of the buildings by means of push buttons, which close tripping circuits in connection with the motor switches.

From the steel bunkers in the boiler house the coal is fed through volumetric measuring boxes, of which there is one in front of each boiler, and down shoots into the stoker hoppers.

The measuring boxes, of the Ingrey revolving box type, are fitted with adjustable shutters for adjusting within small limits their capacity, which is about 4 cwt., and are also provided with counters for registering the number of times each box is emptied.

The whole of this coal-conveying and elevating plant was supplied by Messrs. Spencer & Co., of Melksham, and the coal-measuring boxes by Messrs. Babcock & Wilcox.

Fig. 2 is an outline section through the boiler house showing the position of the steel coal bunkers, having a capacity of about 600 tons, over the centre bay. This building is 115 ft. 6 in. long × 95 ft. wide, and 80 ft. high to the top of the centre bay. The side bays each house five Babcock & Wilcox double-drum water-tube boilers, the latter being fitted with self-contained superheaters, and chain grate stokers of normal type.

Each boiler has a normal evaporative capacity of 19,200 lb. of water per hour at 200 lb. pressure, the steam being superheated to 550° F.

The stokers are driven from an overhead shaft, in front of each block of boilers, which in turn can be driven from either end by a 15-B.H.P. three-phase motor.

Each bank of boilers discharges into a main flue situated immediately behind, and these flues after uniting, lead into a 250 ft. brick chimney, 12 ft. square internally.

6,000 gallons per hour are installed in the pump room. These draw from the hot wells and feed through a Royle feed heater (utilising the feed pump exhausts) to the 4-in. feed range in the boiler house.

(To be continued.)

HOW IT SHOULD HAVE BEEN WRITTEN.

[COMMUNICATED.]

IN my view, the engineer who writes should strive to attain the same object, in his line, as the novelist does in his. The novelist whose characters live, is the one, to my mind, who best fulfils his proper function. In "Painted Rock," for instance, the characters *live*. One can *see* the two candidates for the office of City Marshal . . . . manœuvring to arrest each other.—Mr. SYDNEY WALKER, ELECTRICAL REVIEW, June 28th.

There was me an' A. J. an' Yankee Bill; an' we'd 'ad a 'ell of a time all day. The mains was overloaded, the power-factor down to 0·6, the drop something cruel, and the complaints—I had to answer them—frequent an' not perlite. But the factories was closing down for the night, the lighting load was coming on, the power-factor rising, an' we might hope for a little quiet running till next day. A. J. was chief assistant engineer; we called him Balfowr, for short, 'cos of his initials. Bein' a Radical, he pertended not to like it, but he was no end bucked over it all the same. He 'd read a'most every text-book ever wrote, and thought

D

no one knew anything 'cept 'im. Yankee Bill was a kind o' odd man ; 'ad been everywhere working on jobs of all sorts. Never read a text-book in 'is life, but could *see* things, and 'ad picked up a lot somehow.

"I seen it done over thar," he 'd say, jerking his thumb in the direction he supposed the Atlantic to lie. He thought that Columbus discovered America, and that America had discovered everything since, including himself and his native knowledge of how everything worked. H'd a 'earty contempt for pedantry, grammar and the liter'y engineer. For me, I was a clerk in the office, and looked down on, according ; but as I liked to 'ear 'em talkin' shop an' didn't mind a snub or so, I was tolerated and admitted to their society.

We had finished tea and were smoking in A. J.'s small ill-furnished room. He rose, went to a cupboard, and produced a bottle and glasses.

"What's yours?" to Yankee Jim. "Bourbon."

"And yours?" "Scotch." "I'll take a corpse-reviver, myself," he added, "I need it."

The drinks were poured out, all from the same bottle, and qualified with sparklet soda, for which the station "Partridge" fuses were commandeered, then A. J. let out :—

"I'm fair sick o' this job," said he, "got to run the whole bloomin' show me-self. Mains and plant overloaded ; committee on the pounce, and L.G.B refusing all new loans. . . . "

"Wot biz is that of yourn? That's the boss's job."

"*Was* the boss's job, and will be again ; once he's chucked that peray-si-dential ad-dress off 'is chest. Boss ain't so bad, but there's no gettin' anything out of 'im now. Went to see him about that booster we 'ad a bother with. 'Don't come worrying me,' says 'e, 'fix it up yourself, y' ought to know 'ow. An' while y' are here,' says 'e, ''ow d'ye spell 'ucksterin'?' That's the chief just now. Pass the 'baccy, old man ; I can't get this pipe to draw."

He scraped it out with a broken-bladed knife, filled up, took a drink, and went off again :—

"Not that I blame the L.G.B. neither. Plant's sufficient, and mains is sufficient, if the 'ole bally lot weren't choked up with idle curr'nt. Mor'n 'arf the time, its bigger than the workin' curr'nt."

Yankee Bill, who was chawin', spat thoughtfully into the fire place.

"Wot are y'callin' idle, my son," sed 'e ; "th' curr'nt no more idle than you—not arf ; its the mag-net-i-sin' curr'nt, and 'tends to its own biz—mor'n some folk"—with a look at me—'ow 'ud y'r Ah-Sin-thomous motors go roun' without fields?"

"I didn't know you had any Chinese plant on the mains," I put in.

Yankee Bill honoured me with a lofty stare of superiority, but took no other notice of the interruption. "These 'ere polly-faced motors," he went on, "ain't nothin' but trans-for-mers wi' moving secondaries, an' in course they must be excited. How c'd you run a motor anyway wi'out it. What *you* wan't, me son," turnin' to A. J., "is to keep th' excitin' curr'nt to its work, not 'ave it sloshin' around the generators and thro' the mains 'tween 'ere and the generatin' stashun. I seen it done out yond'r."

"Oh, ah" said A. J., "I spose y' mean me to build a condenser the size of this 'ere station, to localise the idle curr'nt. An who's to pay for that I'd like to know?"

"I spose you got that out o' a blessed text-book : no, y' don't find Bill mucking up wi' tin foil an' greased paper—'e don't call that engineerin'." "*Idle* curr'nt," he went on, with supreme contempt, "D'ye call the waves idle when they pile up the shingle on the beach and drag it down again. That's wot y'r idle curr'nt is doin'. I tell ye, I can *see* the juice sloshin' around in th' armature, an' yankin' the poles forrard, and then tryin' to pull 'em up ; th' generators 'ave to find 'arf that idle curr'nt, an' the other 'arf is wasted 'elpin' the engine wot don't want no 'elp. See?"

"I've seen a liar at times," said A. J. "Wot d'yer mean, letting on ye can see the juice?"

"You never seen nuthin' 'cept diagrams in a book," replied Bill. "It takes imagination to see wot I seen. Now, look 'ere, me son. S'pose you 'ad one generator 'ere to do nothin' else but excite these polly faces, an' leave the station plant to its proper business. It 'ud 'ave to be a big 'un to carry the juice, but it w'dn't take much power, for 'arf the time y'r 'idle' curr'nt would be pullin' it round, an'——"

"An' we can take that power from the mains. Bill, my boy, that's the very thing—an over-excited synchronous motor. An' we have a turbo machine here to try it on ; a bit small, but anything for a beginning. I'll see the chief about it to-morrow. But, I say, when the lighting comes on, won't y'r excitin' curr'nt play old Harry with the generators an' the mains when there's nought for it to do?"

"Don't over-excite y'rself, old man. Over thar we just dropped the field when we didn't want much waste juice."

"Just so ; that 'ud do the trick. Thanks, old fellow! I say, I'll look up what the text-books have on this, an' make a paper of it if the boss will let me."

"Ain't it a little too simple a thing for a paper?" I ventured to ask, turning to go.

"It won't be simple at all by the time I've done with it," replied A. J., scornfully.

And it wasn't.

THE ASSOCIATED MUNICIPAL ELECTRICAL ENGINEERS (GREATER LONDON).

A COPY of a resolution circulated amongst the Electrical Engineers of Greater London, intimating that "this Association is in favour of the 'Supply of Electricity Bill, 1907,' which was unfortunately withdrawn," and in favour of its reintroduction next Session, calls attention to the existence of this body of engineers, which was formed towards the latter end of last year.

It is perhaps early in the day to expect any results beneficial to Greater London undertakings from this young body, especially when we consider that the total initial membership consisted of only 45 engineers and assistants. Its primary object is stated to be "The interchange of technical and commercial ideas for the benefit of the municipal electrical undertakings of Greater London."

From the membership list, we look for some useful information on technical matters, but fail to see much prospect of a useful interchange of commercial ideas, as the Association is constituted entirely of chief engineers and chief assistant engineers, the men with commercial training being conspicuous by their absence. Are the London engineers endeavouring to emulate the ostrich by burying their heads in the sand? As we recently pointed out in connection with the I.M.E.A., greater results would have been the outcome of the last convention had the commercial subjects been treated or discussed by commercial in addition to engineering officials. The real commercial engineer and manager is a rarity seldom met, and we would strongly advise the members of this Association, at the outset of its career, to put prejudice to one side and admit to its ranks the financial assistants from the various local authorities who can, by a little skilful engineering on the part of the chiefs of electricity departments, be induced to assist materially in the commercial progress of the industry. We would also impress upon those members that they are now faced with a battle for their very existence as generating engineers, and that they cannot afford to ignore the commercial element when uniting together to oppose their common enemy, the bulk supply company or authority.

We are aware that the Greater London engineers are alive to the danger before them, for we have heard rumours of a futile effort to arouse the ratepayers in support of their present-day lackadaisical methods, but from what we can learn it was well that the effort was strangled in embryo. Surely in the greatest and most important area in the world, where we expect to find the leading lights of the electrical profession, we ought also to find the commercial side of the industry most highly cultivated. But this is not so, therefore we trust that one of the first efforts made by the new Association will be to encourage the discussion of com-

mercial subjects, and admit commercial assistants to such discussions.

The most glaring defect in the constitution of the new Council of the Incorporated Municipal Electrical Association is the omission of London men, and the reason is not far to seek. The plums of the profession lie in the provinces, and the best metropolitan engineers are attracted thereby, whilst those remaining follow blindly the lead of the provincial engineers. Are they to continue to do so, or are they going to wake up? This Association should help them to become the power in the land that their environment entitles them to become, but they must take the initiative, and the field is wide for their exploitation. First and foremost comes the question of bulk supply, then there are such matters as a revision and uniform adoption of charges for the supply of energy; a uniform system of accountancy; the utilisation of steam power from refuse destructors, with an equitable basis of remuneration for the same; a uniform and equitable method of charging for street lighting; and many other matters of public importance and utility. The young A.M.E.E. will develop on such food as we have indicated; but if they continue to be as exclusive as they have commenced, their ideas will stagnate, and the Association will become impotent or perish in its youth.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

I.M.E.A. Convention.

I am afraid that the points which you criticise in your issue of the 19th inst., in connection with my paper and letter of the 10th inst., are hardly of sufficient general interest to justify my trespassing further upon your space, but you practically compel me to do so by challenging the accuracy of my figures and calling upon me to explain the system by which they are obtained. I thought I had done this in my paper, but evidently you have overlooked or not understood my explanation; I therefore repeat and amplify it.

The total costs (including capital charges) of running the works during each of the four quarters of any year are ascertained as explained in the paper. The output during each quarter is, of course, also known. These figures are plotted, the costs as abscissæ, and the output as ordinates, and 4 points are thus obtained. Through the mean of these points, the curve A B, fig. 1, is drawn. The law of this curve is found to be £2,242 per quarter + 0·6d. per B.T.U. sold.

Now as to the accuracy of these figures, I do not propose to follow in detail your calculations, as they contain inaccuracies considerably greater than those which you seek to rectify in my paper, but if you refer to and analyse the accounts of this undertaking for 1905-6 (a copy of which I think is in your possession) you will see that the total costs were as follows :—

Total working costs	£5,180
Interest and sinking fund	5,939
Total costs (including capital charges)	£11,119

The total costs calculated from the curve referred to are as follows :—

Standing costs: 4 quarters at £2,242 per quarter	= £8,968
Running costs: 917,925 B.T.U. at 0·6d. per B.T.U.	= 2,295
Total costs (including capital charges)	£11,263

You will therefore see that the costs calculated from the curves were within 0·4 per cent. of the actual costs as obtained from the official accounts. Surely even you must admit that for results obtained by graphical methods this degree of accuracy is, as stated in my paper, "sufficient for all practical purposes." I could, of course, quite easily have adjusted my curves, so as to make them agree absolutely with the actual results, but by so doing I should have laid myself open to the charge of "cooking" the curves to suit my purpose.

It appears to me that your criticisms are based upon the erroneous assumption that such items as the "cost of coal" are "running costs." I am surprised that it should be necessary for me to point out to you that a large proportion of cost of coal is a "standing cost," and that exactly what proportion can only be accurately ascertained by some such method as that advocated in my paper. As I thought this method of dividing the "standing costs" from the "running costs" was familiar to those before whom the paper was to be read, I did not consider it necessary to describe it at any great length.

I confess that I am quite unable to understand how you reconcile your statement, that I have "cast a slur upon the intelligence of municipal engineers, &c.," by giving the curves contained in fig. 1 of my paper, with the request made later in the same issue for further information as to how these curves are obtained.

In the last paragraph of your criticisms you take an opinion which I expressed with regard to the curves given in fig. 2 of my paper and apply it to those given on fig. 1. I presume that this misrepresentation is unintentional, for if not, I can only say that in making it you are hardly "playing the game."

I am glad of your assurance that you entertain no antipathy towards municipal undertakings, and I am quite prepared to leave this matter to the judgment of your readers.

I agree with you that there are "black sheep" in municipal as well as in other ranks, and that it is in the interests of the industry in general that they should be exterminated, and that all undertakings, municipal or otherwise, should be run on sound financial lines.

H. R. Burnett,
Borough Electrical Engineer.

Barrow-in-Furness, *July 23rd*, 1907.

[This further letter from Mr. Burnett justifies our criticism of the paper read at the recent Convention. We contended that the curve fig. 1 had no relationship to quarterly costs, but merely represented annual standing charges ÷ 4 plus running costs per B.T.U., and that the latter figure—viz., 0·6d.—was incorrect, which contention Mr. Burnett now confirms. It was totally unnecessary to plot a curve in order to obtain this result, a simple statement of fact, in figures, being ample for any man of normal intelligence.

We regret that the costs given in our issue of 19th ult. were inaccurate. The information was obtained from a useful table of records published by a contemporary, and generally accepted as reliable. From this source we obtained the costs of wages 0·27d., and repairs 0·2d., which do not agree with the official return as given below, viz. :—

Coal, &c.	0·454d.	...	£1,737 16 5
Oil, water, &c.	0·059d.	...	223 16 6
Wages	0 299d.	...	1,144 16 8
Repairs, &c.	0·172d.	...	657 5 8
Works costs	0 984d.	...	£3,763 15 3
Rates, &c.	0·053d.	...	202 11 3
Management	0·317d.	...	1,213 10 9
Total working costs ...	1·354d.	...	£5,179 17 3

But this inaccuracy on our part does not alter the main point of contention—viz., that the figures given in curve fig. 1 are altogether wrong. The difference between £757 per qr. and £398 per qr. is £1,436 per annum, but in the actual balance-sheet figures given above the amount is £1,416. In his paper Mr. Burnett distinctly stated that the curves were plotted from actual results; who, then, would have accused him of "cooking" the curves if he had made them agree with the actual results? To make a curve "more expressive than the figures which it represents," we would imagine that it should be strictly accurate. Mr. Burnett claims to have been within a 0·4 per cent. error which is "sufficient for all practical purposes." We calculate this error at 6·7 per cent. by a process of simple arithmetic from the figures given in above letter, viz. :—

Total costs as per official accounts	£11,119
Planting costs = 4 quarters at £2,242 ...	8,968
Running costs	£2,151
Running costs as per curve	2,295
Error	£144

2,151 : 100 :: 144 = 6·7 per cent.

But possibly Mr. Burnett plotted a curve to obtain the 0·4 per cent. result.

Mr. Burnett thought that the method of "dividing standing costs from running costs was familiar to those before whom the paper was to be read;" we were right, therefore, in assuming that Mr. Burnett has a method. Will he be surprised to know that 99 per cent. of the engineers and committeemen are *not* familiar with it? It is this method that we are anxious to obtain and publish in the interests of the electrical industry, particularly as applied to coal costs, but whether Mr. Burnett comes forward with his method or not it is our intention to go further into the subject and endeavour to establish a workable system, as it is upon this very method that future charges for the supply of energy will be based.

Mr. Burnett accuses us of not "playing the game." We do not understand which game he alludes to, but if it is the national game, he will find that our deliveries are straight, and if misjudged the player will be "bowled out."

We made no reference to "black sheep" in the municipal ranks, but we certainly think that inefficient men are a hindrance to the progress of the industry; also we are pleased, for once, to be in accord with Mr. Burnett's view when he asserts "that all undertakings, municipal or otherwise, should be run on sound financial lines." This is exactly what we desire most to see.—Eds. E.R.]

The Profits of Electrical Manufacturing Companies.

We have read your report of the Electrical Construction Co.'s meeting in your last week's issue, and would point out a mistake which was made by the chairman in his speech. We take considerable exception to this statement, which reads as follows:—"It is but small consolation to know that such absence of profit is not exceptional nor confined to this company, for I cannot find that any electrical manufacturing concern of importance, carrying on a purely manufacturing and competitive business similar to ours, can show any better result, and some show a great deal worse."

We may say that the average dividend which we have paid on our ordinary shares for the last six years is 8½ per cent.; during 1906 we made more profit than in 1905. These dividends were paid after a substantial depreciation had been allowed for. Our profits were stated in the prospectus issued a few weeks ago.

We maintain that our business is practically similar to that of the Electrical Construction Co., as it is purely manufacturing, and we have over 800 employés. We have, of course, a few specialities, but the bulk of our profits are obtained from standard D.C. and A.C. motors and generators. The average size of our productions is probably somewhat smaller than those of the Electrical Construction Co., but we make a range of machines from 1 to 1,000 H.P. The writer also knows several other firms in this country who are making a reasonable profit.

We must say, however, that we consider the prices which are obtained at the present time are much too low, and we entirely sympathise with the remarks made by the chairman *re* the failure of the co-operative scheme. We would also draw your attention to Messrs. Crompton & Co.'s report, in which they declare a dividend of 5 per cent., and place a substantial sum to reserve.

It may also interest you to know that at the present time we are exporting a considerable number of machines to Italy, France and Germany, notwithstanding the high import tariff.

The Lancashire Dynamo and Motor Co., Ltd.,
A. P. Wood.

Manchester, *July 29th*, 1907.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Grinding and Polishing Machine.

The accompanying illustration, fig. 1, shows an electric grinding and polishing machine which is being supplied by Messrs. S. Wolf and Co., of 138, Southwark Street, London, S.E. The firm supplies such machines for a variety of purposes in workshops and installation work. One can be supplied fitted with a slide rest to move parallel with the lathe. Another type is fitted with a longitudinal support and bracket, while a third, as illustrated (type P.B.P.L.), is a portable machine for such work as finishing castings, motor-chassis work, and for polishing and grinding work *in situ*. Particulars of a number of other portable drilling and grinding machines are set out in the firm's catalogue. They supply continuous and single, two and three-phase current machines up to 500 volts.

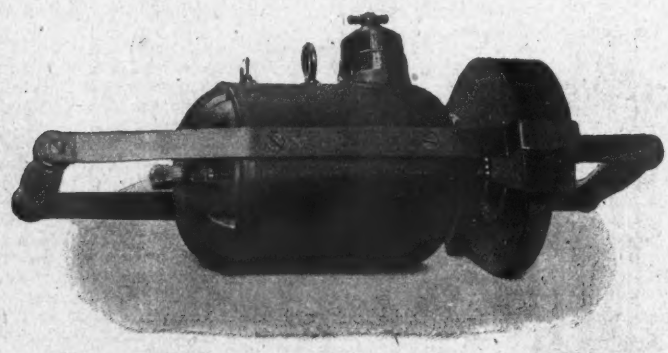


Fig. 1.—Portable Electric Grinding and Polishing Machine.

Waterproofing Tumbler Switches.

The little device, as simple as it is ingenious, which is shown in fig. 2, has been invented by Mr. B. O. Butler, of 8, Cecil Court, Charing Cross. It can be applied to almost any type of tumbler switch, with a slight modification of the cover.

Fig. 2.—Rubber Cap and Washer.

The device consists of a hollow moulded rubber cap, which fits loosely over the dolly, and is gripped between the cover of the switch and a washer or shoulder on the internal bridge. Thus water or moisture is completely excluded from the switch at this point, and it is easy to make the cover fit watertight on the base. At the same time the rubber cover effectually protects the user against a shock from an uninsulated dolly. Particulars can be obtained from the inventor.

Warner Patent Steering Control for Tramcars.

Some time ago we published a description of the new type of radial truck called the "Sinuous" truck, invented by Mr. J. S. Warner. The accompanying illustration, fig. 3, shows the application of the principle to the bearing of one of the cars of the Metropolitan Electric Tramways Ltd., of 8 ft. 6 in. wheel base, which is typical of a number of cars that are being converted to demonstrate the advantages of the system. The view shows the suspending links, which are arranged so as always to swing through an arc of a circle at an angle to the main side-frame. It is claimed that with this system excessive pressure between the wheel flanges and the rails is impossible, so that the unduly rapid wear which has been observed in many cases is obviated. Mr. Warner maintains that in order to secure this result the relative positions of the axles must be continuously changed, so that no two axles are parallel except for an instant occasionally, the wheels thus being enabled to conform continually to the deviations from correct alignment which are met with

even on the best-laid track. The suspension is so delicate that the whole vehicle may be swayed horizontally with one hand, and it is claimed that the cars run with the minimum of shock and vibration.

Returning to the illustration, the links shown on either side of the axle-boxes swing at an angle to the main frame, passing through radial slots in the yoke bridge (the bar passing under the axle-boxes), and connected to knuckle joints concealed inside the journal box

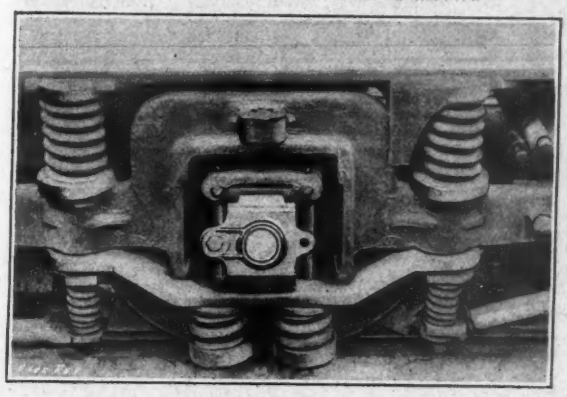


Fig. 3.—Warner Patent Steering Control.

springs. The pins passing through the lower ends of these links are set radially to the king pin in the centre of the car. At the upper ends of the links, where the pins cannot be set radially, pins parallel to the axle are used, passing through a bridge piece which rocks transversely on the axle-box, while at the same time the axle-box itself tilts or rotates to and fro upon its journal. The Warner Engineering Co., of 11, Dartmouth Street, Queen Anne's Gate, S.W., owns the patents.

Dust-proof Twin Carbon Arc Lamps.

The lamp illustrated herewith is one that has been developed by The British Thomson-Houston Co., Ltd., of Rugby, especially for outdoor use, or in foundries and such places where there are corrosive fumes. The line resistance is of the external pattern, suitable for mounting in a pole base or on the wall. With this arrangement the lamp is claimed to run much cooler, and to allow

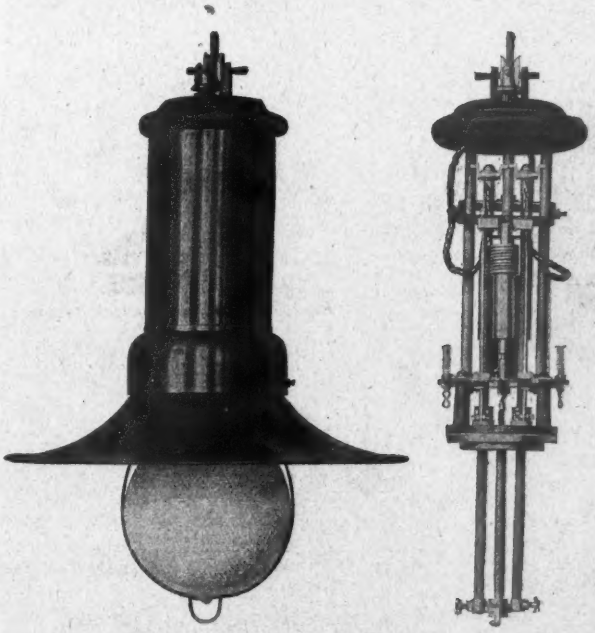


Fig. 4.—B.T.-H. Dust-proof Arc Lamp.

the casing to fit closely and completely box up the working parts. The lamp is suitable for single operation on high-voltage circuits, and is claimed in many cases to show advantages over the two-in-series type, especially for shop and office lighting. It has two arcs in series within the enclosing globe, and consumes about the same power as the 5-ampere series parallel lamp. It is said to give a perfectly steady white light. The carbons are placed close together, and to the observer the effect is said to be the same as if the light emanated from a single arc. The negative carbon-holder is so arranged that no shadows are cast. Ten-mm. carbons are used, and with 12 in. upper and 5 in. lower the lamp will burn approximately 100 hours. The series coil is wound with a patent enamelled copper wire, which is not affected by heat or moisture. The lamp is designed to operate singly on from 200 to 250-volt circuits D.C., and can be adjusted from 2·75 to 3·5 amperes. All the working parts are very accessible, and they can be easily removed for repair or replacement. The length over all is 24½ in., and the weight, including casing and reflector, is 17 lb.

LEGAL.

Northern Counties Electricity Supply Co. *v.* Tann.

At Morpeth Petty Sessions on July 24th, Harriet Tann, a married woman living at Hirst, was summoned by the Northern Counties Electricity Supply Co. on a charge of having diverted a current and stolen electricity to the value of 1d. on May 6th. Mr. T. H. Smirk, Newcastle-on-Tyne, prosecuting, said that an ingenious device had been in operation to divert the current by means of a piece of wire and two pins. The latter had been inserted in the wires, with the result that the current, instead of passing through the meter, passed directly to where the light was wanted. The defendant was fined £1 and costs, and the chairman, Lieut.-Colonel Orde, intimated that if there were any more cases of the sort the penalty would be heavier.

Glendenning *v.* Leeds Corporation.

On July 26th an action was heard at the Leeds Assizes, brought by Mrs. Clara Emily Glendenning, a widow, for damages against the Leeds Corporation. Plaintiff, who resided at 82, Roundhay Road, Leeds, was about to alight from a tramcar when it suddenly started. She was thrown to the ground, rendered unconscious, and suffers from diabetes in consequence. She was awarded £250 damages against the Corporation.

Asylum Installation Claim.

According to a report in the *Manchester Daily Guardian*, an action arising out of the electrification of the Winwick Lunatic Asylum, near Warrington, came before Mr. Edward Pollock, sitting as Official Referee of the High Court of Justice, in the Manchester Assize Courts on July 23rd. The Committee of Visitors for Winwick Asylum claimed £1,200 damages from the Hart Accumulator Co., Ltd., of Stratford, London, for breach of contract. The plaintiffs were represented by Mr. E. Sutton, Mr. J. M'Keever and Mr. J. B. Sandback; and the defendant company by Mr. Thomas Terrell, K.C., and Mr. Valentine Ball. It was mentioned, says our contemporary, that the proceedings were likely to last at least a week.

The case for the plaintiffs was that by an agreement in writing, dated April 10th, 1901, the defendants agreed to maintain and keep for a period of ten years from June 30th, 1902, a storage battery belonging to the plaintiffs up to an efficiency of 90 per cent. of its original capacity, and to do various necessary work on it from time to time. On the other hand, the plaintiffs agreed to replace broken spray arresters and to supply pure sulphuric acid and pure water as required. The remuneration of the defendants was to be £76 10s. annually for the first five years and £110 a year for the second five years. In July, 1904, the defendants were called upon to renew the plates, and then agreed, in modification of the agreement, henceforth to maintain and keep the capacity of the battery at an efficiency not to fall below 80 per cent. of its original capacity. The plaintiffs alleged, however, that instead of doing this they failed to maintain and keep the battery in the agreed state of repair and efficiency, the effect being that the available capacity of the battery fell to 60 per cent.

Mr. E. Sutton stated that in their pleadings the defendants practically alleged that the falling-off in the capacity of the battery was due to want of care and proper supervision on the part of the plaintiffs themselves; and that consequently the defendants' obligations ceased. The contract arose, briefly, as follows:—The plaintiff Committee, becoming anxious to have electric lighting installed, instructed their engineer, who made a specification in which it was stipulated that the battery must be of the most modern type. The defendants sent in a tender for £1,350. The Committee offered to accept this provided the company would agree to maintain the battery after the first five years for a second period of the same duration at the same rate of £76 10s. per annum. This the defendants declined, and ultimately the sum of £110 per annum was settled as their remuneration for the latter five years. The defendants then took complete control. They gave instructions that there should be an ampere-hour-meter to register the exact work the battery was doing, but they now suggested that the meter was so inaccurate in its records that it gave over-charges and over-discharges, and that in consequence they were relieved from their responsibility of maintaining the battery. They argued that it was the business of the plaintiffs to see that the meter was accurate. The plaintiffs, on the other hand, said it was the duty of the defendants, and that if it went wrong the defendants were not relieved of their responsibility. As a matter of fact, men were sent to inspect the battery from time to time, and reports were made and letters written which gave the plaintiffs to understand that the battery was going on perfectly well. Ultimately, however, it was found that the battery had fallen into

a dangerous condition, and the defendants were informed. Only then did the defendants say that they were misled by the ampere-hour-meter. In October, 1894, at the defendants' suggestion, new plates were inserted in place of the old ones, but these also went wrong and began to bend and buckle. Then the defendants suggested that a booster was necessary, and that this should be provided by the Committee. The Committee, however, replied that as the booster was made necessary by certain alterations carried out by the defendants, and as the defendants had undertaken to maintain the battery, the cost of the booster should fall upon the defendants.

The Referee: They say the obligation falls upon you because, according to what they state, the cells became bad through your negligence; and that they are only bound to "maintain and keep" as against ordinary wear and tear.

Mr. Sutton replied that when they made the contract the defendants were supposed to have considered all the risks they would naturally and reasonably incur. All that the plaintiffs had to do was to select men of approved character, skill, and knowledge.

The evidence in the case was very voluminous. One of the witnesses for the plaintiffs was Mr. Stubbs Brown, vice-chairman of the Committee of Visitors for the Winwick Asylum. He said, in the course of his evidence, that he was a member of the "Defective Battery Sub-committee."

The Official Referee: By that, I suppose, is meant a sub-committee appointed to look after this defective battery?

Mr. Tebbell: I thought it was a defective sub-committee to look after the battery.

At the close of the fifth day the hearing was adjourned. It will be continued in London after the Long Vacation.

Marylebone Borough Council and its Consumers.

At the Marylebone County Court last week, Myring & Co., Pemberton & Clark, and Mr. R. J. Knox and Mr. Sobocinski, all Hampstead residents, were sued by the Marylebone Borough Council for amounts said to be due for electrical energy supplied.

On behalf of plaintiffs, Mr. Wilson Bell explained that recently certain portions of Hampstead were transferred to Marylebone, and *vice versâ*, for local government purposes, and that an agreement was come to under the London Electric Lighting Areas Act of 1904, by which the same portions were also transferred for electric lighting purposes. This agreement was confirmed by the Board of Trade, and the section of the Act gave Marylebone the same powers over the new section that it had over the other parts of the borough. The Hampstead rate for electricity was 4d. a unit, but the Marylebone rate was 8d. a unit up to 200 hours' use a quarter, after which it came down to 1d. The defendants had offered to pay on the Hampstead rate, but refused to pay the plaintiffs' full charges.

According to the *Hampstead Express*, each of the defendants in the box pleaded that it was a great injustice for them to be transferred without their consent to a district where the charges they had to meet were greatly in excess of the amount they had previously had to pay.

Sir William Selfe said it was no doubt a grave injustice to the individual, and he strongly sympathised with the defendants, but he was afraid they would have to submit.

Judgment was given for the plaintiffs, but, in view of the importance of the case, his Honour granted stay of execution and leave to appeal.

Cunningham *v.* Marylebone Borough Council.

At the Marylebone County Court on Friday last, the Marylebone Borough Council was sued by Mr. R. N. Cunningham, electrical engineer, of Edgware Road and Brown Court, W., who claimed £86 odd in respect of various items said to be due for work done and goods supplied. Two amounts had been paid into Court.

Mr. Thorn Drury was for the plaintiff, and Mr. Randolph for the Borough Council.

Mr. Drury, in his opening statement, said that in 1905 the Council decided to change their voltage from 100 to 240, and it became necessary for them to conform to the conditions imposed by the L.C.C. The condition which bore on the present case was the one which made it incumbent upon the local authority to make good to the consumers all lamps, fittings, &c., which were rendered useless by the change. One item for which plaintiff sought to recover, £45, was for a motor-generator, which had become necessary by reason of the change of voltage, and which he had purchased on defendants' order. The Council's extremely disingenuous defence to this part of the claim was that the plaintiff had been a consumer at Seymour Place, and not at Brown Court, where the generator was fixed, and where plaintiff was supplied with current only after the change in system. The second item, one of £20, was in respect of new arc lamps which plaintiff, as a contractor to the Council, had supplied to an Edgware Road dealer on a Borough Council official's order, and the rest of the claim was for balance of different accounts for work done for the defendants. The whole business, added Mr. Drury, appeared to have been carried out by defendants in a very unbusiness-like way.

Plaintiff said that he did a large business in charging accumulators, and to do so it was necessary to reduce the original 100 volts pressure supplied formerly. When the 240 volts pressure was put on his position would naturally be made worse, and it was for this reason that the generator was suggested, and finally ordered by defendants. One of the defendants' engineers gave plaintiff permission to order new arc lamps for the job he was doing for the Council at Edgware Road. The official had pointed out that no matter what happened the consumer must not be left without lamps, and that if necessary plaintiff must order new ones.

For the defence, it was submitted that the generator was ordered to compensate plaintiff, as consumer at Seymour Place, for any inconvenience suffered in the change of system. As there was no current previously supplied to Brown Court, the Council would not have agreed to supply the generator there, inasmuch as it would have been plaintiff's place in starting the installation to have put in all fittings, &c., necessary to such installation. The engineer denied having given plaintiff permission to order the four arc lamps for the work in Edgware Road, but said that a payment had been made for the loan of lamps at the address in question.

His Honour finally awarded plaintiff £25 odd—£18 for the arc lamps, £2 19s. 11d. in respect of the balance from accounts, and £5 for loss sustained at Seymour Place. He said he did not think plaintiff could recover for the generator, inasmuch as place seemed the essence of the contract between the parties. The verdict was irrespective of the sum paid into Court.

De la Valette *v.* Riches & Co.

In the King's Bench Division of the High Court, before Mr. Justice Walton and a Common Jury, the hearing was concluded on Tuesday of this case, in which plaintiff claimed for balance of goods sold and delivered. This claim was admitted, and the case was heard on a counterclaim, in which damages were claimed for alleged breach of contract. It was alleged in this claim that in March, 1905, it was orally agreed between plaintiff and Mr. G. T. Riches, on behalf of the defendants, that the latter should be the sole representatives of the plaintiff in Great Britain and Ireland for the sale of plaintiff's patent magneto igniters and the parts of the same until plaintiff's patent should be taken over by a company; and that in the meantime plaintiff should pay to the defendants commission on all goods sold to any customers within the radius mentioned. It was urged that on September 22nd, 1906, by a letter plaintiff refused to continue the agency and to supply the defendants with the patent igniters, although the patent had not been taken over by any company.

The defence in the counterclaim was that plaintiff did not make the agreement alleged, and that no period in which defendants should act as plaintiff's agent was mentioned.

Evidence as to the terms of the contract having been heard, the Jury found for the defendants on the counterclaim, and awarded £750 damages.

The case came again before Mr. Justice Walton on Wednesday, and after hearing arguments on a point of law, his Lordship reserved his judgment.

Hay *v.* Northern Counties Electricity Supply Co.

At the West Hartlepool County Court on July 26th, Francis William Hay sought to recover damages from the defendant company. Mr. Meynell, for the plaintiff, said he resided at 1, Penrith Street, Hartlepool, which was his own property, and there he carried on the business of a general dealer. The defendant company had erected a power station just behind the plaintiff's house about three years ago. Originally, the power station contained one light engine, but others were put in as the business developed, until, with the noise and the vibration, it became an intolerable nuisance. The consequence was serious damage to the house and the things in it. They were told by the company that the plant was going to be removed. Mr. Gawan Taylor, for the defendant company, said that in six months it would pass out of their hands. The station was not going to be used for generating electricity, but only as a sub-station. The plaintiff and William Young, an architect, gave evidence as to the manner in which the vibration had affected the house. The latter witness said there had been a subsidence through the vibration, causing certain walls of the house to crack.—James Bainbridge, a builder, gave it as his opinion that the noise was very intense and detrimental to anyone's health.—After other evidence had been given for the plaintiff, Mr. H. Taylor, electrical engineer to the Middlesbrough Corporation, was called for the defence. He said he found, after tests, very slight vibration, in fact, not sufficient to account for the damage complained of. In this opinion he was supported by the assistant manager of the defendant company's works. Other evidence was given to the effect that the cracks in the plaintiff's house were of a long standing nature.—His Honour gave judgment for plaintiff for £10 for the annoyance he had sustained.—A similar claim by a Mr. Rowland was adjourned.

Smoke Nuisance Prosecution.

On July 26th at Westminster, Mr. Curtis Bennett continued the hearing of the summonses against the Underground Electric Railways of London, Ltd., for black smoke nuisance at their generating station in Lot's Road. Evidence was given by Dr. Louis Parkes, medical officer of health for Chelsea, who said he could not suggest anything in the generating of electricity to improve upon the methods adopted by the defendant company. Sometimes there was black smoke, sometimes there was none, and consequently he was of opinion that the emission could be remedied. He knew the load varied from time to time. R. J. Davis, sanitary inspector, cross-examined, said he had not calculated that the four chimneys at Lot's Road were equivalent to 2,000 domestic chimneys, nor that nine times the amount of coal the 2,000 domestic grates consumed was consumed at Lot's Road. The hearing was again adjourned.

PARLIAMENTARY.

Royal Assent.—The following Bills have received the Royal Assent:—

Electric Lighting Orders Confirmation Acts Nos. 1, 2, 4 and 5, 1907.

Portobello and Musselburgh Tramways (Levenhall Extension) Order Confirmation Act, 1907.

London United Tramways Act, 1907.

Great Northern and City Railway Act, 1907.

Central London Railway Act, 1907.

London and North-Western Railway Act, 1907.

Electric Supply Corporation, Ltd., Act, 1907.

Bills Advanced.—In the House of Commons on the 26th ult. the Lords' amendments to the North Metropolitan Electric Power Supply Bill and the Richmond (Surrey) Electricity Bill were agreed to.

The Tramways Order Confirmation Bill on Tuesday passed the Ways and Means Committee, and was ordered to proceed. The Bill confirms Board of Trade orders, with respect to the following places: — Audenshaw, Huddersfield, West Ham, Taunton and Leeds.

The Middlesbrough, Stockton-on-Tees, and Thornaby Tramways Bill was read a third time.

The Electric Lighting Provisional Orders Bill (No 3) came before the Unopposed Committee of the House of Commons (Mr. Emmott presiding) on Thursday last week, and was ordered to go forward. The Bill confirms electric lighting orders granted in respect to Castleford, Egham, Formby, Liversedge, Coombe, Mansfield, Grimsby, Selby, Paignton, Stoke-upon-Trent and Maldens.

On Friday Mr. Corrie Grant's Committee again had the Bill of the Glasgow Corporation before them, which, amongst other matters, authorises the construction of new tramways. The Bill has been several times before the Committee over the question of the estimates for sewers, and Mr. Balfour Browne, K.C., on behalf of the Corporation, now expressed regret that incorrect figures should have been given by a witness. The Chairman announced that the Committee would pass the estimate of £41,862 for tramways. At present the Corporation had 31 years as a general period for the repayment of their tramway loans. The figure which the Committee allowed was 30 years, but as there was only a year of difference, and a good many of the tramway loans had been repaid, and as it was a remunerative undertaking they would make an exception and allow the tramway loan to be put under the general period now in operation in Glasgow. The preamble of the Bill was then passed.

On July 26th the Telegraphs (Money) Bill was read a third time in the Commons.

BUSINESS NOTES.

The Bastian-Calvert Leading-in Wire for Lamps.—On Friday last, at 71 and 73, East Road, Hoxton, many who take an interest in movements for ameliorating the lot of crippled children attended the formal opening of a new factory in which, with the co-operation of the Ragged School Union and Shaftesbury Society, industrial occupation is given to a number of cripple girls. The factory has been started by Platinum Substitutes, Ltd., to manufacture glass-coated copper strips on the Bastian-Calvert system to form the conducting wires for electric lamps, in place of platinum. To begin with, some 30 girls are employed, but it is expected that before long work will be found for some 200 or 300. The girls are selected by a matron paid by the Ragged School Union, who will "mother" them during the first few months of their industrial experience. The Lord Mayor of London, whose chief work during his term of office promises to be his now renowned efforts already so successful on behalf of the Cripple Children's Fund, was present to start the factory, purely in the interests of his charitable enterprise, and not because of any connection with, or personal knowledge of, this particular commercial undertaking. The directors of Platinum Substitutes, Ltd., say that they are employing the cripples solely on strictly commercial lines. During the first month or two of tuition the employés receive from 3s. to 5s. per week, plus 3s. per week meal allowance, which it is anticipated will rise to 15s. and meal allowance, depending on skill, under a bonus system. The Bastian-Calvert invention has been patented in all countries, and the company anticipates that "in a short space of time the use of platinum in the manufacture of incandescent electric lamps will have been entirely superseded." Leading English and Austrian manufacturers are stated to have taken the system up enthusiastically. Mr. Newman, the secretary, said that the company had brought to the district a new industry which was destined to work a revolution in incandescent lamp manufacture. They had offers to manufacture more cheaply abroad, but they preferred to let the manufactured article (including the labour) go to the foreigner as export. Before the Lord Mayor pressed his button, starting the motor operating the factory in the basement floor, Mr. C. Orme Bastian, the company's technical manager, gave what was described on the programme as a "technica *résumé*." It will be remembered that he fully described the system in a paper read several months ago before the Glasgow Section of the I.E.E. (see ELECTRICAL REVIEW, June 21st, p. 1027).

Mr. Bastian said that the principal point in the new invention was that it claimed to preserve a better vacuum in the lamp than had been possible hitherto. The importance of maintaining a thoroughly good vacuum was not properly appreciated by the public at large. A bad vacuum not only affected the efficiency of the lamp, but it also affected the light. What was more important still, was that a lamp with a bad vacuum might be using 25 per cent. more current during the whole of its life, and that meant a waste of energy enormously greater than the cost of the lamp, and for the extra energy thus used they did not get more light—in fact, they might get less light than under the better conditions. The high price of platinum induced manufacturers to cut down the quantity used in each lamp to the very finest possible limit, and that tended to the production—some lamp manufacturers might object or not agree—of inefficient lamps. They believed that this invention would entirely supersede the use of platinum.

The Lord Mayor then started the factory, and in doing so, said that it was not much good starting a factory employing cripples unless with the belief that it was going to be a commercial success, because otherwise it would not last. He did not understand this invention, he did not understand the terms of electricity. When hungry as a boy, he was told that he had a "good vacuum." Hereat everybody laughed, notwithstanding the great crush and the tropical heat. Some of the guests then partook of "light" refreshments before proceeding below with their poor vacuums to see the cripples engaged at their new industry.

Electrical Accidents in 1906.—Referring to the article in our last issue on "Electrical Accidents in 1906," MESSRS. CARSON & EVANS, of 3, Fenchurch Buildings, E.C., inform us that for some time past they have been urging upon engineers in charge of electricity supply stations the advisability, for the benefit of both parties concerned, of adopting some more satisfactory method of safeguarding their employés, and from many replies they have received, they are convinced that this matter is having most careful attention. Mr. Scott Ram's report fully bears out their contention that the individual insulation of all dangerous metal parts is necessary, and that the protection now given by means of fencing and iron cages is not adequate. At the request of the engineer of one of the largest power stations in London, they carried out experiments in insulating bus-bars and other dangerous parts with a thick coating of high grade ebonite, with the result of the adoption of this principle throughout the station, and they are prepared to undertake experimental work of this description for any engineer who may be interested, as they are confident that it is the only system which can be regarded as satisfactory. The work above-mentioned was carried out between May and September, 1906, and they received a report that it was entirely satisfactory in February last.

A Canadian Electrical Exhibition.—There is to be an electrical exhibition at Montreal, in the Government Drill Hall, for a fortnight commencing September 2nd. It is being run by the Canadian Electrical Exhibition Co., and the Canadian Electrical Association will hold its meeting in the same city from September 11th to 13th inclusive. *Canadian Electrical News* says that: "Mr. R. M. Wilson, superintendent of the Montreal Light, Heat and Power Co., will present a paper on the very interesting subject 'How to Increase the Load Factor,' and Mr. M. A. Sammett, of the same company, will discuss some of the difficulties encountered in operating alternating current systems. Other equally interesting papers will be submitted on 'Frazil Ice,' 'New and Old Type Incandescent Lamps,' 'The Nernst Lamp,' 'Electric Heating and Cooking Appliances,' &c. There will also be a splendid programme of entertainment, and a visit to Montreal during the early part of September is bound to be one of pleasure and profit to all electrical men." If any English electrical manufacturers or suppliers contemplate an early personal study of the Canadian market, perhaps they may find it worth while to fit in a visit to Montreal Exhibition to see what is already on the ground.

Book Notices.—*American Street Railway Investments.*—The fourteenth annual edition of this volume has been issued by the *Street Railway Journal*, of 114, Liberty Street, New York. The character of the publication is already familiar to our readers through the notices which have appeared of previous editions. It is described as the "Electric Traction Red Book," and the present edition consists of some 400 large pages devoted to reports, in many cases accompanied by maps, &c., of more than 1,400 operating and controlling companies in the United States and Canada. Information relating to the capital, dividends, operating receipts and expenses, plant and equipment, *personnel*, and so on, of these tramway undertakings is given. To anybody interested in the electric traction systems of America the book should be very valuable as a work of reference. The price is $5 per copy.

Metric Weights with English Equivalents. By H. P. McCartney. London: E. & F. N. Spon. 1907. Price 1s. net.—The title of this little book explains its contents; it is mainly useful only for conversion from metric to English measures, as the latter are not given in integral values. The equivalents advance by single grammes up to 100, afterwards by 50 to 1,000, and on to 1,000 kg. by single kilogrammes. The limit of the tables is 50,000 kg.

In addition to Avoirdupois, tables for Troy weight are given. We strongly object to the use of the abbreviation "kilos." for kilogrammes; the proper form is kg., the prefix alone being meaningless. The equivalents are given both in tons, cwt., qr., lb. values, and in lb. only with decimals usually to four places. These alarming decimals extend the equivalent in many cases to eight figures—an absurdly meticulous degree of accuracy. Five figures at the very most amply cover the possible accuracy of commercial weighing machines (in actual practice, probably three figures would more closely represent the limit).

Annuaire International de l'Acétylène. 1907. Paris: Office Central de l'Acétylène. Price 2 fr.—This work, now appearing for the first time, is intended to contain all the information required to keep one *au fait* with the progress of acetylene and its applications. After dealing with the theory and technique of the subject, a variety of apparatus is described, a number of diverse applications and processes are explained, and Governmental regulations are given, with a directory of societies, manufacturers, &c. From a list of calcium carbide factories it appears that the United Kingdom has no share in the industry; but this is not quite correct, and we hope that in no long time a large business will be developed. Although we have not the abundant water-powers enjoyed by many countries, electrical energy can be generated as cheaply here as elsewhere, given a suitable load. The total annual production of the world is about 140,000 metric tons of carbide. There are about 150 French towns and villages, mostly of populations between 1,000 and 3,000, that are lighted by acetylene; in Germany there are 112, and in the United States about 200.

The August number of *The World's Work* contains an interesting article by Mr. A. A. Campbell Swinton on "The Story of the Steam Turbine and its Inventor." The early life of the Hon. C. A. Parsons, his experimental work, and his ultimate success are, of course, very important parts of such a story. The history and progress of the turbine from the date of its application in driving small electric lighting plants down to its employment in the largest seagoing vessels—of which the *Lusitania* is the latest and finest example—form a very striking and important chapter in nineteenth and early twentieth century achievements. Most engineers know the story, but Mr. Campbell Swinton will have performed a useful service by placing the matter before the non-technical reader in the article in this monthly magazine.

"Proceedings of the American Society of Mechanical Engineers," July, 1907. Vol. 28, No. 11. New York: The Society.

"Prüfung elektrischer Maschinen und Transformatoren." By Friedrich Weickert. Hanover: Dr. Max Jänecke. 1907. Price M. 1.80.

"Die Krankheiten elektrischer Maschinen." By Ernst Schulz. Hanover: Dr. Max Jänecke. 1907. Price M. 1.40.

"Die Montage elektrischer Licht-und Kraftanlagen." By H. Pohl. Hanover: Dr. Max Jänecke. 1907. Price M. 2.40.

Messrs. Sampson, Low, Marston & Co. will shortly publish a work on "Standard Polyphase Apparatus and Systems," by Maurice A. Oudin.

Paterson Purifiers. — Amongst other orders lately received by the Paterson Engineering Co., Ltd., are the following:—

For the Birmingham Corporation, for Summer Lane generating station condensation water purifier fitted with quartz sand filters, capable of removing all trace of oil from 350,000 lb. of condensed steam per hour. This order was placed by Messrs. Belliss & Morcom, who, we understand, have had a "Paterson" grease eliminator in continuous operation at their Ledsam Street works for the last three years.

For Ayr electricity works, combined exhaust heater, softener and grease eliminator of 4,000 gallons hourly capacity, fitted with quartz sand filter.

For Barnsley electricity works, combined grease eliminator and make-up softener of 8,500 gallons hourly capacity, fitted with quartz sand filter.

Bankruptcy Proceedings.—E. Bohm.—On Monday, at the London Bankruptcy Court, the first meeting of creditors was held before Mr. E. Leadam Hough, Official Receiver, under the failure of Ernest Bohm, Boxworth Grove, Barnsbury, electric lamp manufacturer. The chairman reported that a statement of affairs had been lodged, showing total liabilities £2,731 (unsecured £1,131) and an estimated surplus of £18,269 in assets over liabilities. According to the debtor's statement when before the Examiner, he began business in 1883 as a lamp manufacturer without capital, in Red Lion Street, Clerkenwell, E.C. In 1890 he took additional premises in Little Britain, and two years later he was joined in partnership by another person, who provided £500 capital. They traded together until the latter part of 1903, when they were prevented from making and selling certain lamps, with the result that they were compelled to close the business. In 1901 the debtor brought out the Bohm Lens lamp, and subsequently entered into arrangements to dispose of it to a company, but nothing came of them. In 1903 he entered into an agreement with a firm which undertook to form a company to take over the patent. The firm carried on the business without forming any company, paying him for two years at the rate of £5 a week to manage it. Subsequently he instituted legal proceedings against the firm, but while the action was pending the Bohm Lens Lamp Co. was formed. A judgment was eventually obtained against him, and these proceedings followed. The debtor attributed his failure to a certain syndicate having given, without his knowledge, a mortgage over the patents, in respect of which the judgment was obtained. The case was left in the hands of the Official Receiver, it being intimated that the debtor hoped eventually to pay all the debts in full.

G. F. Frizell.—The first meeting of creditors was also held on Monday under the failure of George Fredk. Frizell, late of 175, Clapham Road, S.W., carrying on business as the Electric Laundry Co. It appeared that the debtor commenced the above business in November, 1906, and continued it until July 13th, when it was sold at the request of the largest creditor, who took the proceeds after payment of the outgoings. He started originally in 1900, in partnership with a Mr. Louis, as electrical engineers, without capital, at 179, Denmark Hill. That business was continued until September, 1905, when it was sold for £575, the dissolution of the partnership was gazetted, and the firm's liabilities were discharged. The debtor attributed his failure to insufficient capital and bad debts. His statement of affairs showed liabilities £464 (unsecured, £415) and net assets £1 11s. 6d. In the absence of any offer, the case was left in the hands of the Official Receiver to be wound up in bankruptcy, the debtor's public examination being fixed for August 27th.

Garrick Electrical Co.—Under the failure of A. H. Dodd and H. J. A. Whateley, trading under this style at Walsall Street, Bilston, and late of Wolverhampton, the partnership liabilities are £32 and the deficiency £21.

R. S. Blackburn.—At the Burnley Bankruptcy Court on July 26th, R. S. Blackburn, electrical engineer and contractor, formerly of Hebden Bridge, attended for his first public examination. His gross liabilities amounted to £1,429, of which £1,354 was expected to rank. Debtor attributed the cause of his failure to sickness and heavy expenses in connection therewith, and pressure of creditors. He said he commenced business in a small way in 1883 without any capital. He borrowed money from time to time to the extent of about £1,000 to develop the business, of which money he still owes about £600. He estimated that his turnover in the business had been about £1,500 a year, but he could not estimate what profit he had made. There were 65 unsecured debts, 19 of which amounted to £1,165. The examination was adjourned till August 30th.

Consular Notes. — Mexico.—The *Board of Trade Journal* says that H.M. Consul at Mexico City (Mr. L. J. Jerome) draws attention to the demand in Mexico for electrical appliances such as electric incandescent or arc lamps, high and low tension cables for transmission lines, dynamos and motors, either steam or water-driven, &c. Many of the tramway systems are being altered from animal power to electric power. Factories are largely using motors, direct coupled, instead of the overhead system pulleys and belting for power transmission to machine tools. Mr. Jerome says that nearly all the electrical appliances used at present in that country are American.

Catalogues and Lists.—Mr. S. H. Heywood, Reddish, near Stockport.—16 pp. pamphlet describing electric pulley blocks, runways, and motor friction hoists, and containing a number of half-tone views showing them in service.

Union Electric Co., Ltd., London, S.E.—List No. CC1, giving prices, &c., of arc lamp carbons. This is supplementary to the firm's previously issued list of Excello carbons.

Messrs. L. E. Wilson & Co., 20, Cross Street, Manchester.—Four-page catalogue containing illustrated description with prices of their "Thomson" patent pocket electric lamp.

Messrs. Major & Co., Ltd., Sculcoates, Hull.—8-page circular relating to their insulating varnish, No. 1 quality (stoving).

Messrs. Watlington & Co., Moorgate Station Chambers, E.C., who last year took over the supply business department of Messrs. Robert W. Blackwell & Co., Ltd., are now issuing their own catalogues. Three of these have just come to hand. Section I is a 24 pp. illustrated list of the Anderson electric railway and tramway supplies (insulators and line material). Section II describes a variety of tramway tools, such as portable rail saws, track drills, bonding, digging, and overhead line tools, car-shed tools, and air compressors. The third publication is a 60-page illustrated catalogue of Cee Bee circuit breakers made by A. Goldie Engholm, of Birmingham, for whom Messrs. Watlington are London agents. Other lists are shortly to be issued, a section now in the press being devoted to fuses, lightning arresters, &c.

Messrs. Crompton & Co., Ltd., Salisbury House, E.C.—16-page pamphlet (D29), containing particulars with illustrations of their continuous-current ceiling fans.

Messrs. Rands, Robson & Co., Dacre House, Westminster, S.W.—Circular relating to their Victoria fuseboard, also a list tabulating particulars and prices of the "Morley" standard continuous-current dynamos, for which they are agents.

Messrs. R. J. Nicholson & Co., writing with reference to a notice which appeared in these pages last week, ask us to state that, although their pamphlet "Light in the Country" is written with the object of interesting the private householder, it is distributed only through the medium of the electrical trade, to whom are supplied copies gratis, with the name of the contractor circulating it printed thereon.

The Scottish National Exhibition.—The arrangements for the Scottish National Exhibition of 1908 to be held at Edinburgh, have made good progress. The plans, subject to any alteration which may be deemed advisable, have been accepted, and work on the grounds and buildings will commence by the end of this or the beginning of next month. In the accepted designs, the Industrial Hall of 100,000 sq. ft., and the Machinery Hall of 20,000 sq. ft., are included in one magnificent building. The classification of the various sections includes fine arts, education and history, arts and crafts, mining, engineering and metallurgy, transportation and motive power, shipbuilding and waterways construction, chemistry and scientific appliances, lighting, heating and ventilation, agriculture, horticulture and sylviculture, domestic economy, sports and pastimes, botany and zoology, artisans' work, women's section, urban and rural improvements. Full information as to charges for floor space in the Industrial Hall can be obtained from the manager, Mr. W. H. Knight, 45, York Place, Edinburgh.

Swansea Destructor.—At a meeting of the Swansea Streets Committee last week, a record was reported in connection with the work of the destructor, 1,731 tons being dealt with during June, or an average of 69¾ tons per working day; 86 tons was the most dealt with on one day. The destructor consists of five cells of the Horsfall "back-feed" type, and was erected by the HORSFALL DESTRUCTOR CO., LTD., in 1904.

Trade Announcements.—MESSRS. FOXCROFT AND DUNCAN, of Phœnix Works, Mentmore Terrace, London Fields, N.E., announce that their works will be closed from Friday evening, August 2nd, to Monday, August 12th. No goods will be dispatched or received during this period, and only urgent correspondence will be dealt with.

The partnership that has existed between NORMAN MCKENZIE and WALTER TREVELYAN WRIGHT, electrical and mechanical engineers, 4, Watts Place, Chatham, has been dissolved. Mr. Wright will carry on the business under the style of Walter T. Wright & Co.

We are asked to say that W. Zoebell, printed on page 131 of our last issue under this section, was a mistake for W. Loebell. The name of the company, too, we now understand to be the Sächsiche Bronze Electrical Fittings Manufacturing Co., Ltd.

MESSRS. CROMPTON & CO., LTD., notify that their works will be closed from noon on Saturday, August 3rd, until 9 a.m. on Monday, August 12th. All communications should be sent, as usual, to the head office.

The JOHNSON-LUNDELL ELECTRIC TRACTION CO., LTD., notify that their works will be closed for the annual holidays from Saturday, August 3rd next, until Monday, 12th idem, and their offices from Saturday, August 3rd, until Wednesday, 7th idem.

The works of MESSRS. J. HOPKINSON & CO., LTD., Huddersfield, will be closed from Friday, August 2nd, to Monday morning, August 12th, for the summer holidays.

MESSRS. J. and E. HALL, Dartford, Kent.—These works will be closed from August 5th to the 10th for stocktaking and annual audit purposes.

The LANGDON-DAVIES MOTOR CO., LTD., Deverell Street, London, S.E.—The works and offices will be closed from August 5th to the 10th for the annual holiday. A small staff will be in attendance to deal with urgent matters.

The CRYPTO ELECTRICAL CO., 155-7, Bermondsey Street, S.E., have appointed MR. S. Mansel Jones, of 63, Wind Street, Swansea, and also 7 and 8, Western Mail Chambers, Cardiff, their sole agent for the sale of their dynamos, motors, transformers, &c., for South Wales.

THE NEW BROTHERTON TUBE CO., LTD., Wolverhampton, notify us that their works and offices will be closed from Monday, 5th inst., to Saturday, 10th, for holidays and stocktaking.

The works and offices of the DISTRICT ELECTRIC CO., of Wolverhampton, will be closed from Monday, August 5th, to Saturday, August 10th (inclusive), for the annual holiday.

Dissolutions and Liquidations.—BROCKIE-PELL ARC LAMP, LTD.—A petition for winding up this company, or for continuing the winding up under the supervision of the Court, has been presented by Gent & Co., of Leicester, creditors, and is to be heard in London on August 7th. The company on July 19th passed a resolution winding up voluntarily with Messrs. R. Warner and D. Watson as liquidators.

CONDUITS & FITTINGS, LTD.—This company, meeting at West Kilburn on July 29th, passed a resolution winding up voluntarily, with MR. H. D. Brown, 4, Monument Street, E.C., as liquidator.

HUDSON ECONOMISER CO., LTD.—Creditors should send in particulars of debts, &c., to Mr. D. F. Basden, 33, St. Swithin's Lane, E.C., the liquidator, by August 17th.

MESSRS. HEAP & JOHNSON, 28, Hatton Garden, London, E.C., have dissolved partnership as from July 29th, 1907. Mr. E. F. Johnson will continue the business under the same name and attend to debts.

LONDON ELECTRICAL SYNDICATE, LTD.—A meeting is to be held at 54, New Broad St., E.C., to hear an account of the winding up from the liquidator, Mr. Wm. R. Gaff.

Electrical Clocks at Charing Cross.—The South-Eastern and Chatham Railway has taken advantage of the reconstruction of Charing Cross station to install a system of electric clocks. Two 57-in. drum clocks have been suspended from the roof girders over the Continental departure platform and the distant local platform. Both have double internally illuminated dials, and are driven from a single pendulum giving half-minute impulses. We understand that the installation has been carried out by the LOWNE ELECTRIC CLOCK CO., of Catford, S.E.

Developments at Consett Ironworks.—During the past 12 months various improvements and extensions have been in course of progress at the blast furnaces and steelworks of the Consett Iron Co., Ltd., and some time ago a contract for a 400-KW. turbo-generator, required in connection with an additional blast furnace at Consett, was placed with MESSRS. C. A. PARSONS AND CO., of Heaton, Newcastle-on-Tyne. In connection with the addition to their blast furnaces, the Consett Co. are also to introduce eight large Stirling boilers, each having a heating surface of 3,220 sq. ft., and each capable of evaporating 12,000 lb. of water per hour. These boilers will be fired by blast furnace gas, and the steam generated will be used in the Consett steelworks.

D.P. Battery Contracts.—During the past fortnight, THE D.P. BATTERY CO., LTD., have secured contracts for the erection of storage batteries (over 1,300 cells of 1,270,000 watt-hours' capacity) at Fleetwood, Tadcaster, Ilford, Brechin, Montrose, Alderley Edge, and other places. During the past month they have completed power installations at Southampton Docks for electric cranes; at Portsdown, Gosport and Pontefract, for electric tramways; at Letchworth (Garden City), Stratford-on-Avon, Mansfield; and several smaller contracts for the Admiralty and War Office.

LIGHTING and POWER NOTES.

Amersham.—The Missenden and District E.L. and Power Co. has informed the R.D.C. that it intends applying for a prov. order for E.L. for the parishes of Great and Little Missenden, Lee, Charteridge, Chesham, Bois and Coleshill.

Billingham.—The P.C. proposes to light Haverton Hill and Port Clarence by electricity instead of, as at present, by oil lamps. The estimated annual cost is £258 against £329 paid for oil lamps.

Bristol.—The Corporation Electrical Committee has recommended the T.C. to apply for a loan of £38,000 for the extension of the extra high pressure three-phase system to the docks.

Canada.—OTTAWA.—The civic electric plant during the first six months of the year shows a gross profit of $14,000. Of this $7,600 is to be allocated for interest and sinking fund on capital account, leaving a net profit of $7,059. The net profit will go largely in covering the depreciation of the plant. Delay has occurred in the signing of the contract with the Ottawa and Hull Power Co., and meantime the power company has made changes in the clauses of the agreement, so that the civic commission now refuses to sign the contract. Recently the power company gave the city notice that unless the contract was signed by July 21st the power would be cut off. It is now considered almost certain that the city will buy out the Ottawa electric plant *en bloc*. It will then not only have its own power, but it will be in a position to supply all the citizens with light and power, and have no competitor in the field. In making this drastic move, the city will be amply backed up by the citizens.

Castleford.—The Electrical Distribution of Yorkshire, Ltd, has informed the U.D.C. that it is negotiating for a bulk supply of electricity for the town.

Continental Notes.—SWITZERLAND.—The negotiations between the Swiss and Baden authorities for the construction of a hydraulic power station on the Rhine at Augst, near Baden, which have lasted several years, have been concluded, and, according to *l'Industrie Electrique*, the work will shortly be put in hand. The intake on the Rhine will be below Rheinfelden, and the head will be 8·4 m. The gross power available will be 75,000 KW., and two stations will be constructed, one on the Swiss side of the river and one on the German side.

GERMANY.—A fire recently occurred in a sub-station in Berlin, where energy received from the Moabit power station at 6,000 volts is converted to D.C. at 2 × 220 volts. The transformers are oil-cooled, and one of them in some way sprang a leak; the oil spread over the ground and caught fire, igniting the other transformers, and eventually the whole station was destroyed.

Coventry.—The accounts of the Corporation electricity department for the past year, show a net profit of £5,115. It is proposed use to £1,000 of this in relief of rates, and to place the balance to reserve. The profit is the largest in the history of the undertaking.

Edinburgh.—By 28 votes to 17, the T.C. has decided to place its balance of £9,919 to the relief of the rates. Saner financial methods were advocated by many speakers, who were, however, outvoted.

Grassington.—It is proposed to install a suction gas-electrical plant for supplying electrical energy in the village for private and public lighting.

Hull.—The Corporation Asylums Committee has appointed a Sub-Committee to consider the advisability of providing an E.L. installation for Willerby Asylum. The estimated cost is £8,530.

Ilford.—The U.D.C. has decided to substitute electric lamps for the present oil lamps in the outlying districts of the town, and to apply to the B. of T. for consent to use overhead wires for the supply of energy.

London.—CITY.—At the meeting of the Corporation on July 25th approval was given to the following proposals for experiments in improved electric street lighting:—(1) By the City of London Electric Lighting Co. on the Holborn Viaduct by means of flame arc lamps on standards; in Farringdon Street, including Holborn Circus and the Old Bailey (part) by enclosed arc lamps; and in Newgate Street by smaller lamps; the charges for such lamps to be at the rate of £17 10s. each for the flame arcs instead of the existing charge of £26 per lamp, and for the smaller lamps £12 10s. and £10 10s. per annum each respectively; (2) by the Charing Cross, West End, and City Electricity Supply Co., Ltd., in Cannon Street (between Budge

Row and St. Paul's Churchyard) by means of centrally hung flame arc lamps, at a cost of £17 10s. per lamp per annum. All costs of installations, including the standards, lamps and maintenance, are to be at the expense of the companies. The necessary works are to be proceeded with as expeditiously as possible, and the demonstrations are to be continued until March next.

At the meeting of the Thames Conservancy on Monday, it was resolved to approve a proposal of the L.C.C. to improve the lighting of Westminster Bridge by the substitution of electric lights for the present gas lamps, so as to dispense with gas lighting altogether.

Woolwich.—The B.C., at its last meeting, decided that the time was not yet opportune for adopting either of the alternative policies for the undertaking suggested in Sir A. B. W. Kennedy's report. It was absolutely necessary, however, to increase the capacity of the steam plant at Woolwich works to meet next winter's load, and it was agreed that Davey, Paxman & Co.'s tender at £1,855 for the three boilers, and the Sturtevant Engineering Co.'s tender at £260 for the induced draught fan be accepted. It was further agreed, under certain conditions, to place the charge for street lighting upon the maximum demand system, so that the Works Department shall not be charged at a higher rate than any other consumer.

St. Pancras.—Permission has been given to the Hampstead B.C. to supply premises in Highgate, close to the latter Council's mains, as the St. Pancras mains are some three-quarters of a mile distant.

L.C.C.—The question of loans to local authorities was raised at Tuesday's meeting of the L.C.C. on the presentation of the report of the Finance Committee in reference to three borough council loans. Mr. H. Ward contended that the Council should promote a fresh electricity supply Bill in order to stop the waste of money on small generating stations. Captain Hemphill stated that the sum of £6,000,000 was invested in borough council electric lighting undertakings, that £367,000 was expended by them in 1906-7, that £109,270 had been expended this year, and the amount of £32,000 was proposed on that occasion. That made a total of £500,000, which would be practically useless in 10 years' time. In his opinion the Highways Committee should consider the expediency of advising the Council on the subject of introducing a new Bill to deal with the question. Mr. Buxton, on behalf of the Finance Committee, stated that the Committee had under consideration the question of the annuity and the instalment systems of repaying loans. After further discussion, it was decided to lend £14,000 to the Hackney B.C., repayable on the annuity system, for the provision of a 1,500-kw. steam dynamo, leaving a sum of £7,700 for mains to be considered after further inquiry. It was also decided to lend £11,145 to the Hammersmith B.C. for additional mains, plant, house services and meters, and the sum of £5,600 to the Poplar B.C. for the extension of plant and mains.

Marylebone.—The Electric Supply Committee of the Borough Council circulated their annual report on Tuesday, pointing out that as the 12 months under review was the first complete year of the Council as a supply authority, the results were of the greatest importance. The total capital expenditure to March 31st amounted to £1,965,605. The gross revenue from consumers during the year was £155,594, and the total revenue £158,459. Working expenses, management, &c., absorbed £49,818, and other expenses brought the total under this head to £52,727. The cost per unit sold averaged 1·45d. (as compared with 1·622d., estimated in March, 1906), made up as follows:—Generation, ·77d.; distribution, ·22d.; management, ·30d.; rent, rates, &c., ·16d. The management expenses were, in the opinion of the Committee, still unduly high, chiefly owing to the very heavy burden placed upon the department incidental to the change of pressure during the earlier part of the year. The average price charged for current was 4·7d. per unit, including meter rent, showing a reduction of 9 per cent. compared with the average charge during the previous 12 months. The total sales showed a substantial advance, and progress was being made with a view of securing an increased use of the supply for power purposes. The result of the year's work was a net balance of £22,061 The Committee submitted as an appendix, a report by Messrs. Price, Waterhouse & Co., with respect to the institution upon commercial lines of a depreciation and equalisation of renewals fund, and stated that in accordance with the recommendations therein they had decided, subject to the usual sanction, to place the net balance to a reserve fund.

Manchester.—The Corporation has intimated that on and after August 1st it will only connect to its mains consumers' installations which have been carried out by firms approved and registered by the Electricity Committee.

An inquiry was held on July 22nd by Mr. A. W. Brightmore (L.G.B. inspector) into the application of the Electricity Committee for sanction to borrow £112,850 for the purposes of electricity extensions.

It was pointed out that the business of the department was growing, and the Committee, which was looking ahead, would require £60,498 for additional mains. This amount would certainly be expended within three years, and it was understood that it was the practice of the L.G.B. to allow an authority like Manchester a blank cheque for a purpose of this description. There was no opposition, and after Mr. S. L. Pearce (chief electrical engineer) had given evidence of the work required to be done, the inquiry closed.

Sevenoaks.—The B. of T. has informed the U.D.C. that the E.L. Order, 1903, has been revoked as from July 20th.

Sheffield.—A special committee of the City Council has been appointed to investigate the financial position of the electric supply undertaking; this is understood to be due to the fact that the E.L. Committee is proposing to spend £250,000 on the undertaking during the next five years.

Walthamstow.—The adjourned L.G.B. inquiry into the application by the U.D.C. to borrow £17,349 for steam generating plant (the amount being reduced from £26,395 asked for in the first instance), was held last week, and resulted in a further adjournment at the instance of the inspector, to allow of the attendance of the consulting engineer and late electrical engineer to the Council with a view to giving evidence as to the gas engine plant.

Willesden.—The revenue of the electricity undertaking for the past year amounted to £20,294, and the gross profit to £6,661. A deficiency on the year (allowing for extra financial charges paid) resulted of £16. Altogether 1,441,894 units were sold, 88,198 8-c.p. lamps being connected.

Wolverhampton.—A L.G.B. inquiry was held on July 23rd relative to the application of the T.C. for a loan of £35,000 for electricity purposes—viz, £30,000 for the generating station (building extensions, £4,500; boiler house plant, £6,690; engine room plant, £18,500) and £15,000 for mains. Included in the loan was an item of £16,000 in connection with the contract for a supply to the works of Messrs. Bayliss, Jones & Bayliss, who would require 1,000 kw. There was no opposition.

Yardley. — An extension of the period prescribed, within which the undertakers under the Yardley R.D. Electric Lighting Order, 1906, may transfer the undertaking to the Corporation of Birmingham of two months from the 20th inst., has been granted by the B. of T.

TRAMWAY and RAILWAY NOTES.

Blackpool.—The result of an arbitration between the Corporation and the Blackpool, Lytham and St. Anne's Tramway Co. has just been announced. Some little time ago the company obtained an extension of its running powers in the southern portion of the borough, undertaking to pay £250 a year and a further 9 per cent per annum upon the cost of the alterations to the lines made by the Corporation. The latter authority stated that the alterations cost it £2,353, which the company considered excessive. Mr. R. P. Wilson, as arbitrator appointed by the Board of Trade, had the matter submitted to him, and after a two days' inquiry, awarded a sum of £1,008, on which the Tramway Co. will pay at the rate of 9 per cent. Each party will pay its own costs.

Bolton.—The Corporation has granted permission to the South Lancashire Tramways Co. to run over its route from Moses Gate to Green Lane, Great Lever, on the occasion of the Royal Lancashire Agricultural Show.

Bradford.—An alarming accident occurred on Wednesday last to a car proceeding down Church Bank, the steepest gradient in the city. The car ran away, leaving the rails at the bottom of the hill, and crashed into a warehouse, 12 people being more or less seriously injured.

Continental Notes.—Italy.—The Italian Government has decided to appropriate 70 millions of francs to the installation of electric traction on various lines, mostly presenting very steep grades and long tunnels. The Government has also sanctioned a high-speed electric railway between Rome and Naples, 200 km. in length; the existing railway is 250 km. long, and the journey lasts five hours, which will be reduced to two hours on the new route. A combination of Italian, Belgian and French capitalists will carry out the work.—*L'Industrie Electrique.*

Austria.—An electric motor-'bus service, in which the vehicles while running on the ordinary roads collect energy from an overhead cable, has just been started between the railway station and the centre of the town of Gmund.

Spain.—The new electric tramways in the town of Carthagena have just been completed and put in operation.

Holland.—It is reported that the Government of Holland has under consideration a scheme for the establishment of a comprehensive network of electric railways which would serve for the local and distant traffic of the inhabitants in the German-Belgian-Dutch frontier provinces. According to the project, an electric railway would be constructed from Maestricht to Aix-la-Chapelle, with a connection with the Belgian railways. The supply of power would be effected from the central station of the Aix-la-Chapelle Secondary Railway Co. at Kohlscheid.

Edinburgh.—The *Financial Times* states that a correspondent telegraphs that a proposal has been made by a syndicate to buy out the Edinburgh and District Tramways Co., to electrify the lines and take them over on a 60 years' lease. The syndicate is prepared to pay to the Town Council the whole of the capital expenditure on the tramways, to come to an arrangement which will be satisfactory to the directors and the shareholders, to convert the whole system on the overhead electric principle and to add 10 or 12 miles to it. The proposed 60 years' lease is stated to be out of the question.

Gloucester.—A special committee is to be appointed to inquire as to whether the tramways can be leased on terms favourable to the town; a further committee is being appointed to consider the working of the tramways with a view to improving the service.

Haslingden.—Negotiations are proceeding with the Accrington T.C. respecting a through-running arrangement over the tramways in that town after reconstruction and electrification.

London.—At the East London Railway meeting, on July 23rd, Lord Claud Hamilton said that the main factor in their decreased revenue had been the falling-off in the passenger receipts due to the electrification of the District, and more recently the Metropolitan Railway, and the non-electrification of their own line. He had obtained a rough estimate of the cost of electrifying their line from Mr. Firth, the electrical engineer of the Great Eastern Railway. He had mentioned two systems to that gentleman—namely, the direct-current third and fourth rail system and the alternating-current overhead conductor system; but on consideration, he had come to the conclusion that, as the latter system was in its infancy as regarded railways in this country, and they had had no practical experience of its working and cost, and as the Metropolitan and the District were equipped with the former system, it would be more to their purpose to confine the estimate to the direct-current third and fourth rail system. Mr. Firth very kindly undertook to survey their line and prepare the necessary estimates, and his conclusions were as follows:—To equip the whole 12 miles of single track would cost £32,000, but that would not include point-rodding, signal-wiring and other details comprised under the head of "track alterations," but probably they would not amount to much. If the supply of power could be obtained from outside sources both north and south of the Thames, the track-work for that purpose would cost £20,000, which, added to the former figure, made £52,000, and if, owing to the difficulty of obtaining a supply for the southern section, a sub-station had to be erected south of the Thames, there would be a further cost of £18,000, or £70,000 in all. He imagined, however, that a direct supply could be obtained, but even in that case the cost would be £52,000.

L.C.C.—The Highways Committee of the L.C.C. has brought forward a number of proposals for the extension or linking-up of certain portions of the tramways in respect of which it is considered desirable that the Council should seek Parliamentary authority in the session of 1908. The schemes for new lines are as follows:—(1) A double line between Gray's Inn Road and Caledonian Road, over King's Cross (Metropolitan Railway) station; (2) a single line from King's Cross Road to Gray's Inn Road, *viâ* Swinton Street; (3) single lines from Essex Road to Kingsland Road, *viâ* Englefield Road and Stamford Road; and from Kingsland High Street to Mare Street, *viâ* Ridley Road and Dalston Lane, and junction line between Kingsland Road and Dalston Lane; (4) junction line between Mitcham Road and Tooting High Street; (5) double line from existing tramways in Blackfriars Road to existing tramways in Southwark Bridge Road, *viâ* Southwark Street; (6) from the present horse tramway terminus at West Norwood to the Crystal Palace, single lines, *viâ* Chatsworth Road, Idmiston Road and Rosendale Road to Park Road and Robson Road; double line, *viâ* Park Road, South Croxted Road and Dulwich Wood Park; and single loop line, *viâ* Dulwich Wood Park, College Road, Crystal Palace Parade and Farquhar Road; (7) and a double line from the authorised tramways in London Road, Forest Hill, to the Crystal Palace, *viâ* Sydenham Hill and Crystal Palace Parade. It is also proposed to seek authority to reconstruct the tramways in Lea Bridge Road, and to extend the lines to Upper Clapton Road. The overhead trolley system is in contemplation for the extensions to the Crystal Palace, and for the connecting line in Lea Bridge Road. The total capital expenditure on the schemes, which will come forward for consideration after the summer vacation, is estimated at £351,000, of which the sum of £229,000 represents the cost of constructing and equipping the lines, and £122,000 the expense of effecting street widenings in connection with the work.

Luton.—By 15 votes to 4 the T.C. has decided to seal the agreement for the lease of the tramways to Messrs. J. G. White & Co.

Middlesex.—Under the agreement between the County Council and the Metropolitan Electric Tramways, Ltd., the County Council has to provide the land for car-sheds, &c. The company has acquired about 56,358 ft. for a depôt at Wood Green, and the county valuer has valued the site, and reports that the total expenditure of the company on the same is £4,965, and the expenditure on the buildings is £8,405. The County Council at its meeting on July 25th decided that the first-mentioned sum should be charged as capital expenditure, on which the company has to pay interest to the Council, and that the sum of £8,405 charged in the lessee company's tramway capital expenditure be agreed to.

Sunderland.—Two serious tramway accidents occurred at Silksworth on July 30th. The tramcar running to Herrington and Houghton-le-Spring was proceeding down a bank, when the brakes failed to act and the car ran away, dashing through a stone wall. Fortunately the car did not overturn, but ten of the passengers received cuts and bruises and suffered from shock. As soon as they had been attended to, attempts were made to release the damaged car, when a second and similar accident happened. Another car, in coming down the same bank, also ran away, and crashed into the already damaged car. The driver was hurt and some of the passengers complained of shock, but after resting awhile they were sent to their destination by a special car.

Wolverhampton.—The Tramways Committee of the Corporation has decided to recommend to the Council the extension of the Lorain tramway system from the centre of the town to Penn-fields. The route to be traversed is now served by motor-omnibuses. The passengers carried by these 'buses for the 12 months ended March 31st last were 496,911; receipts per car-mile, 10·107d.; miles run, 56,409. This, it is claimed, shows a distinct demand for transit to town from the public of Penn-fields and Lea Road districts. The estimated cost of the proposed tramways is £18,300, and it is hoped that the new service will be commenced next spring. Additional snow-ploughs are to be provided for the tramways.

TELEGRAPH and TELEPHONE NOTES.

Japanese Cable Steamship.—A new vessel has been constructed in Japan for cable laying, to the plans of Professors Shiba and Suyehiro, at Nagasaki. The two vessels hitherto employed were made abroad. The c.s. *Ogasawara-Maru* is of 1,455 tons, twin screw, 72 m. long, and has a beam of 10·2 m.; it is driven by engines of 1,380 H.P., and has three cable tanks, respectively 6·2, 8 and 7 m. in diameter, capable of holding 600 km. of deep-sea cable.—*L'Industrie Electrique.*

Postal Service Inquiry.—The Select Committee appointed to inquire into the wages and positions of Post Office servants has reported at considerable length. The tenour of the report is mainly negative, the Committee finding no sufficient reason for varying existing conditions except in a few minor respects. It is recommended that male telegraphists should be paid on a scale ranging from 20s. to 65s. per week, and female telegraphists from 18s. to 40s., and the Committee is of opinion that the latter should be made liable to perform Sunday duty, from which they are at present exempt. For female telephonists the present scale is endorsed, but the maximum is made 28s. For provincial sorting clerks and telegraphists, a fixed scale of pay is recommended, instead of the existing "unit of work" system, and the male clerks will be able to reach a maximum of 40s. to 56s. weekly, according to the class of town concerned. The maxima for female clerks are 28s. to 36s.

Radio-Telegraphic Convention.—On Tuesday Sir E. Sassoon moved the adjournment of the House of Commons to call attention to the report of the Select Committee on the Radio-Telegraphic Convention, and to the intention of the Government to ratify the Convention without affording the House an opportunity for discussing it. In reply, Mr. Haldane defended the Government, pointing out that no hardship was inflicted on the Marconi Co., which under the agreement with the Post Office of 1904 had accepted the obligation of intercommunication in the event of the Post Office subscribing to the Convention. The Government departments and Lloyd's all supported the Convention, which the Marconi Co. alone opposed.

Telegraphic Interruptions and Repairs:—

Cables.		Interrupted.	Repaired.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Closed..	Jan. 12, 1906 ..	..
Reissa-Issa and Reissa-Yemani (Yemen) ..		Oct. 23, 1902 ..	..
Tarifa-Tangier		Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)		Mar. 9, 1904 ..	..
Garachico-Santa Cruz		July 12, 1906 ..	..
Las Palmas-Arecife		Aug. 18, 1906 ..	..
Brest-Dakar		July 22, 1907 ..	..
Gibraltar-Tangier		July 29, 1907 ..	..
Landlines.			
Puerto-Barrios		Aug. 2, 1902 ..	..

Telephone Tariffs.—The Postmaster-General has this week announced that the rates of subscription to provincial exchanges of the Post Office have been recently revised on the basis of a measured rate, under which the payment made by each subscriber corresponds with the quantity and quality of the telephone exchange service that he receives. The minimum cost of an exchange line has been increased from £4 10s. to £5 a year, but 500 local calls are now allowed for £5, instead of 480 as under the former rate. The rate charged for local calls in excess of 1,000 per annum has been reduced from 1d. to ¾d., and for calls above 2,000 to ½d. A cheaper two-party-line service is also given. The unlimited service rate is not now offered to subscribers.

Wireless Telegraphy.—According to a correspondent of the *Times*, the Marconi Wireless Telegraph Co. of Canada is taking legal proceedings against the Canadian Government, to enforce its claims regarding communication with ships passing through the Straits of Belle Isle. The company alleges that the Government, which has hitherto respected its agreement with the company, has of late adopted a changed policy in favour of Government ownership of the wireless system, to the detriment of the company's interests. In the meantime, the Belle Isle route is deprived of wireless telegraphic means of communication.

It is reported that a German engineer has invented a new portable wireless telegraph station, the total weight of which is only 70 kg., the cost £300, and the radius of communication 25 miles. The existing German military station is very much more heavy and costly.

The *Standard* reports that a German syndicate has purchased

from the Marconi Wireless Telegraph Co., Ltd., one of its associated companies, the International Marine Communication Co., which was formed to acquire all the rights of ship-to-shore communication throughout the world. The parent company holds all but 4,000 of the 350,000 shares.

CONTRACTORS' COLUMN.

Openings for New Business.

ASHFORD CARBONEL (Salop).—New vicarage in connection with church (£1,500). Lloyd Oswell, architect, Shrewsbury; Estcourt and Sons, builders, Gloucester.

ASHTON-IN-MAKERFIELD.—New Independent Methodist Chapel at Stubshaw Cross.

BARNSLEY (Cudworth).—Club premises for the Albert Club. Geo. Moxon, architect, 26, Church Street, Barnsley.

BELFAST.—Corporation contemplates large lodging house in Ballymacarrett.

BILSTON.—New public school (accommodation, 1,360 scholars).

BIRMINGHAM (Handsworth).—New church at Handsworth Wood (£5,000). Rev. Dr. Burn, rector.

BIRKENHEAD (Great Meols).—New church (£6,000 to £7,000). E. Kirby, architect, 60, Beresford Road, Birkenhead.

BLACKBURN.—New elementary school at Blakey Moor.

BOLTON.—Two new hospitals and doctor's house (£11,000). A. Cooper, clerk to the Guardians.

BRADFORD.—Nurses' home and isolation block, and alteration of existing city hospital, Leeds Road. F. E. P. Edwards, city architect, Whitaker Buildings, Brewery Street, Bradford.

BRAMPTON (Cumberland).—New schools (£2,920). John Heward, builder, Brampton.

BRECHIN.—New Post Office. Secretary, General Post Office, Edinburgh.

BURY.—Extensions and improvements at the Bury District Joint Board's Hospital at Ainsworth (£1,800).

New volunteer drill hall (£10,000).

BYFLEET.—New St. Nicholas home for crippled children at Pyrford.

Extension of the Village Hall, E.L. to be installed throughout.

CAMPBELTOWN.—Hotel (four storeys).—Archibald Johnston, Campbeltown.

CAMPSTALL (Cheshire).—Alterations and additions to Campstall Council Schools for the Cheshire Education Committee. H. Beswick, county architect, Newgate Street, Chester.

CARDIFF (Lingfield).—New "Cory Home" (£1,356).

CARLISLE.—Girls' Secondary Schools (£11,629). J. & R. Bell, builders, Nelson Street, Carlisle.

CLACTON-ON-SEA.—Office buildings for E. J. Gilders & Co., auctioneers. Baker & Wrightson and W. J. Almond, joint architects, Clacton-on-Sea.

COLCHESTER.—Extension of Colchester Royal Grammar School. H. C. Wankiyn, clerk to Governors, Town Hall, Colchester.

CORK.—Extension to the Biological Laboratory, Queen's College.

COVENTRY.—New Technical Institute for the Education Committee.

New Council School in Leicester Causeway (£18,000). Fredk. Foster, architect, Coventry.

DARTMOUTH.—New Post Office. E. H. Back, architect, Dartmouth.

DEVONPORT.—New Sunday Schools (St. Barnabas) (£3,000). Chas. Cheverton, architect, Pearn Bros., builders, Gillwell Street, Plymouth.

DONCASTER (Balby).—Extensions to St. John's Church (£3,600). Rev. A. M. Bollard, Vicar.

DONCASTER (Ardwick-le-Street).—New Council Schools (£7,200).

(South Elmsall).—New Public Schools (7,200).

DOUGLAS (Isle of Man).—Extension of St. Matthew's Church (£1,200). F. A. Pearson, architect, 12, Mansfield Street, London, W.; Mark Carine, builder, Auckland Grove, Douglas.

DUBLIN.—Improvements and enlargements to the premises of the "Prison Gate Missions." G. P. Beater, architect, 17, Lower Sackville Street, Dublin; B. W. White, contractor, Summerhill.

Additions to St. Kevin Schools, Grantham Street. W. Byrne and Son, architects, Suffolk Street, Dublin; Ben. Millard, Pleasant Street, Dublin, builder.

New Public Library in Gt. Brunswick Street. City architect, Municipal Buildings, Cork Hill, Dublin.

Rebuilding of Medical Mission premises. G. P. Beater, architect, 17, Lower Sackville Street, Dublin; J. and P. Good, Ltd., Great Brunswick Street, Dublin, builders.

DUMBARTON.—New Post Office. W. T. Oldrieve, H.M. Office of Works, Edinburgh.

DUNDALK.—House for J. Hughes in Point Road. J. F. M'Gahon, architect, Roden Place, Dundalk.

EBBW VALE (Mon.).—New Congregational Church. Henry Waters, architect, Ebbw Vale.

EAST GRINSTEAD (Sussex).—Enlargement of St. Agnes' Schools (£7,000).

EXETER.—Important extensions at Hele's Schools (£7,600).

FELLING-ON-TYNE.—New Wesleyan Church (£3,000). Robert Davidson, builder, Felling-on-Tyne.

GRAYS (Little Thurrock).—New Public Schools (£6,806). H. J. Carter, builder, Argent Street, Grays.

GRIMSBY.—New Congregational Church (£7,082). Hewins & Goodhand, builders, Eleanor Street, Grimsby.

HAMILTON.—Hippodrome. E. H. Bostock, New City Road, Glasgow.

HEBDEN BRIDGE.—Proposed new weaving mill, for the Eaves Self-Help Manufacturers, Ltd.

HOWDON-ON-TYNE.—New schools (£3,514). Nichol Ritchie, builder, Whitley Bay.

ILFORD.—Baptist Church in High Road. G. Baines & Son, 5 and 6, Clement's Inn, Strand, W.C., architects.

IVYBRIDGE (Devonshire).—Alterations and additions to Ivybridge Council School for the Devon County Education Committee. Architect, 1, Richmond Road, Exeter.

KINGSTON-ON-THAMES.—Gymnasium. Alfred Mason, Victoria Road, Surbiton, architect.

LEEDS.—New Baptist Sunday Schools (£3,913). Fred Holland, architect, Leeds.

(Rothwell).—New Council Schools (£3,600).

(Thornton-in-Craven).—New public schools (£5,760).

LIMERICK.—New hall and business premises in Cecil and Henry Streets for St. Michael's Temperance Society. B. E. F. Sheehy, architect, 57, George Street, Limerick.

LLANRWST (Llyn Eiddau).—New aluminium works, electrically equipped. Boot & Hennitt, Ltd., builders.

LONDON (St. Pancras).—Technical instruction centre for L.C.C. (£2,700). McCormick & Sons, Northampton Street, Essex Road, builders.

(St. Pancras).—Enlargement to L.C.C. school. Patman & Fotheringham, Park Street, Islington, builders.

(Highgate).—Electric light to be installed in Lord Mansfield's house, "Kenwood."

(Whitechapel, E.).—Buildings in Brick Lane. J. R. Moore Smith, 14, Union Court, E.C., architect.

(Marylebone, W.).—Additions to St. Paul's (Portman Square) schools. T. Henwood, jun., 7, New Quebec Street, W., builder.

(Kensington).—Rebuilding Rugby Mission Club. Nicholson and Corlette, 2, New Square, Lincoln's Inn, W.C., architects.

(Golder's Green).—Shops and semi-detached villas. J. Gibb, 191, West End Lane, N.W., agent.

(Golder's Green).—Shops. W. J. King, agent, 7, Heath Street, N.W.

(Kensington).—Garage on part of the site of Alexandra Square.

(Wandsworth).—Enlargement of L.C.C. School (£5,293). J. and C. Bowyer, Upper Norwood, builders.

(Brixton).—L.C.C. School (£2,816). E. B. Tucker, 82, Lavender Hill, S.W., builder.

(Lewisham).—Laundry in Leahurst Road. Norfolk and Prior, Catford, architects.

(Greenwich).—Offices in Blackwall Lane for Maple & Co., Tottenham Court Road, W.C.

(Cricklewood).—Mission church. J. S. Alder, 1, Arundel Street, Strand, W.C., architect.

(Westminster).—Saw mills in Commercial Road. Weatherall and Green, 22, Chancery Lane, W.C., surveyors.

(Hammersmith).—Railway station buildings. H. Townsend, Paddington Station, W.

(Alexandra Park).—Congregational Church. Mummery and Fleming Williams, Wood Green, N., architects.

(Walworth, S.E.).—Rebuilding premises for Grose Bros., drapers (£11,000). G. A. Lansdown, 9, Regent Street, S.W., architect; Geo. Parker, 124, Summer Road, S.E., builder.

(Stratford).—Premises for Boardman & Sons, furnishers and drapers (£12,900). G. Baines & Son, 5, Clement's Inn, W.C., architects; F. G. Minter, High Street, Putney, builder.

(Battersea).—Additions to Lawn House Laundry, Orkney Street, for T. Barrett.

(Woolwich).—Sorting office for Postmaster-General.

(Leyton).—Additions to factory for Shenstone & Co., pianoforte dealers, 226, High Road, Leyton.

MAESTEG (Caerau).—Place of worship. J. D. Morgan, secretary, 6, Caerau Road, Caerau.

MANCHESTER.—Important extensions at Victoria Station. E. Taylor & Sons, builders, Littleborough, Rochdale.

Extension of warehouse premises for Hall, Higham & Co., merchants, Dale Street. Architects, C. Heathcote & Sons, London and Manchester.

MERTHYR TYDFIL.—New Church, St. John's, Penydarren (£2,300). Bruce Vaughan, architect, 21, Dumfries Place, Cardiff; Gough Bros., builders, 1A, Wellfield Road, Cardiff.

NEWBURY (East Ilsley).—New public schools (£1,833).

NORTH ORMESBY (Yorks.).—Conversion of houses into shops. F. Walshaw, architect, 59, Lorne Terrace, South Bank (Yorks.).

NORWICH.—New church at Thorpe Hamlet (£1,376). J. Owen Bond, architect, 29, Castle Meadow, Norwich; John Hurn, builder, Surrey Street, Norwich.

NOTTINGHAM (Burton Joyce).—New Wesleyan Church (£1,850). A. E. Lambert, architect, 22, Park Row, Nottingham.

OLDHAM.—New spinning mill for the Rome Spinning Co. E. Stephenson, builder.

Additions to Vernon Works for Stott's, ventilating engineers.

(Uppermill).—New cotton mill to be built (50,000 spindles).

ORMSKIRK.—Extensions to Ormskirk Grammar School (£2,000).

PENRITH (Plumpton).—New church (£2,068).

PETERBOROUGH.—Wesleyan Chapel at Farcet (£1,050). J. Cracknell, builder, Peterborough.

PLYMOUTH (Mutley).—New Baptist Sunday Schools and lecture hall. F. A. Wiblin, architect, Westwell Street, Plymouth; Ambrose Andrews, builder, Plymouth.

PRUDHOE (Northumberland).—New public school to be erected by the C.C. (£3,685).

RATHDOWNEY (Queen's County).—Extensive alterations to R. Williams and Sons' premises and to the Commercial Hotel. E. Bradbury, architect, Nassau Street, Dublin; Wm. Beckett, builder.

ROCHDALE.—New public schools. W. A. Peters & Sons, builders, Crossfield Mills, Rochdale.

Block of shop buildings in Newgate. H. H. Clough, architect, Rochdale.

Music hall.—Mr. Wm. Standring, Rochdale.

SALTFLEETBY (near Louth).—New Primitive Methodist Chapel.

SIDCUP (Kent).—Children's Homes to be rebuilt for Greenwich Board of Guardians. Dinwiddy & Sons, architects, 12, Crooms Hill, Deptford, S.E.

SION MILLS (Co. Tyrone).—New church. W. F. Unsworth & Son, architects, Petersfield, England.

SKIBBEREEN.—Proposed additions to the Town Hall. Mr. Caverley, town surveyor.

SKIPTON.—New infirmary wing and consumptive block at the workhouse (£3,000).

STOCKPORT.—New cotton mill for the Stockport Ring Spinning Co., Ltd. Plans in preparation.

New Council school for the districts of Bramhall and Hazle Grove. The Cheshire County Education Authority.

STOURBRIDGE.—New Unitarian Sunday Schools. T. Grazebrook, architect; J. Guest & Son, builders, Ambleoote, Stourbridge.

STRATFORD-ON-AVON (Dorsington).—Bungalow residence for Mr. G. E. Wilmott. E. G. Holtom, architect, 58, Henley Street, Stratford-on-Avon.

TORQUAY (Chelston).—New Wesleyan Church (£1,418). H. Phare, builder, Torquay.

TOTNES (Devon).—Infirmary (80 beds), receiving wards, porter's lodge, and nurses' apartments for the B.G. W. F. Tollit, architect, 10, High Street, Totnes.

WAKEFIELD.—Extensions to the workhouse.

WEST HAM.—Proposed new schools at Wanstead.

WHITEHAVEN.—Semi-detached villa residences. J. S. Moffat, architect, Whitehaven.

WIGAN.—Developments contemplated at Pearson & Knowles' Coal and Iron Co.'s pits.

WIGTON (Cumberland).—New police station. County architect.

WILLESDEN.—20 houses in Gladstone Park Gardens. G. H. Paine, 62, Moorgate Street, E.C., architect.

Shops in High Road and Christchurch Avenue. G. A. Sexton, 42, High Road, Kilburn, N.W., architect.

WOLVERHAMPTON.—Important extensions to the Grammar School. J. Hutchings, architect to Staffs. C.C. Education Committee.

WYLAM (NORTHUMBERLAND).—New Council schools (£3,230).

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—January 8th, 1908. One common battery switchboard and 3,000 subscribers' telephones (specification No. 166) for the Deputy Postmaster-General, Adelaide. Specifications can be seen at the Commonwealth Office, 72, Victoria, Street, S.W.

Austria.—August 31st. The Austrian State Railway authorities at Czernowitz are inviting tenders for the establishment of an electric plant at the railway station in that town, for lighting and power purposes.

Barnes.—August 12th. Mechanical stokers, feeder and distributor cables for the U.D.C. See "Official Notices" July 26th.

Belgium.—August 14th. La Société Nationale des Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels, is inviting tenders for the machinery and apparatus necessary for the equipment of three transformer sub-stations in connection with electric tramways.

Calcutta.—January 2nd, 1908. According to the *Financial News*, tenders for any class of illuminant are invited by the Corporation for the lighting of the city.

Dortmund.—August 15th. The Prussian Railways require tenders for a 20-ton electric crane and accessories.

Dublin.—Supply of motors on hire-purchase system for the Corporation E.L. Committee. See "Official Notices" July 26th.

Egypt.—November 1st. The Harbour authorities require tenders for the construction of an electric power station at the port, and for the following plant, to be worked by electric power:—Five transporters of large range; five ditto of smaller range; six cranes of 4 tons each; 36 cranes of 2 tons each; 25 capstans; cables, feeders, &c. Particulars may be obtained from the Directeur des Posts and 'Phones.

Gothenburg.—The Commercial Intelligence Branch of the Board of Trade are notified by H.M. Consul at Gothenburg that tenders are invited for the supply of the electric equipment for the Government power station at Trollhattan. For further particulars see this column for July 26th.

Italy.—August 8th. The municipal authorities of Leghorn are inviting tenders for the electric lighting of certain public streets of the town.

Londonderry.—At the committee of management of the Londonderry Lunatic Asylum, held at Coleraine on the 26th ult., the specification submitted by Mr. R. V. Macrory, A.I.E.E., for spare dynamo and other electric plant at Gransha was submitted, and it was decided to consider tenders at the September meeting.

Manchester.—August 3rd. Tenders are invited by the Corporation Sanitary Committee for one 35-KW. D.C. generator, direct coupled to a high-speed engine set, for the Baguley Sanatorium. Tenders must be received by the Town Clerk before 9 a.m., August 3rd (to-morrow).

Mansfield.—Maintenance of electric installation at the Town Hall for the T.C. J. Harrop White, Town Clerk, Mansfield.

New Zealand.—The T.C. of Napier require tenders for a complete electric lighting, tramway and power installation.

Paddington.—August 12th. Electrical installation of fire alarms at the workhouse in Harrow Road, for the Guardians. Specification, &c., from H. F. Aveling, Clerk to the Guardians, 313-319, Harrow Road, W.

Portsmouth.—August 5th. Welsh steam coal for the tramways power station. See "Official Notices" July 19th.

Portsmouth.—August 14th. High-tension switchboard, and pipe-work for electricity supply extensions. See "Official Notices" July 26th.

Queensland.—September 9th. The Deputy Postmaster-General requires tenders for the supply of lead-covered paper-insulated telephone cable, also various post and telegraph stores, telegraph and telephone instruments, parts, &c. Specifications of the above, and of a number of other tenders for telegraph and telephone material, may be inspected at this office.

South Australia.—The Postmaster-General requires tenders for lead-covered paper-insulated telephone cable with 12½ conductors, as follows:—7½ miles 208-pair; 3½ miles 156-pair; 4 miles 104-pair; 2½ miles 78-pair; 7 miles 52-pair; 2½ miles 26-pair; and 700 yards light lead-covered silk and cotton-insulated cable.

Spain.—August 12th. The Spanish Ministry of Public Works in Madrid is inviting tenders until August 12th for the concession for the construction and working of an electric tramway in the town of Valencia.

Stockport.—August 26th. Automatic point controllers for the T.C. See "Official Notices" to-day.

Sunderland.—August 22nd. Uniforms and caps for the tramway employés of the Corporation. See "Official Notices" July 19th.

Sydney (N.S.W.).—August 14th. The Deputy Postmaster-General is inviting tenders for telegraph, telephone and electric light material.

CLOSED.

Bolton.—The Tramways Committee has accepted the tender of Hadfield's Steel Foundry Co., Sheffield, for the supply of tramway crossings.

Bath.—The T.C. has accepted the tender of the National Telephone Co. for the provision of electric fire alarms (14) and alarm bells at 20 firemen's houses, at £131 per annum for seven years.

Blackpool.—The E.L. Committee has accepted the tender of Messrs. Foster & Co., of Preston, for the supply of a boiler, at £447.

Cleckheaton.—The Bradford Electrical Engineering Co. have obtained the tender for the E.L. installation at the new post office at Cleckheaton.

East Ham.—The T.C. has accepted the following tenders for the supply of slack coal for the generating station:—

Rickett, Smith & Co., Babbington rough slack, 360 tons, at 14s. 3d. per ton.
E. & A. Shadrack, Nuneaton pea slack, 360 tons, at 11s. 3d. per ton.

Leyton.—The U.D.C. has accepted the following tenders for the supply of tramway stores for the ensuing year:—

Electrical accessories.—General Electric Co., Ltd., tumbler switches, 2s. 4d. each; two-way switches, 1s. 8d.; batteries, wet, 1s. 11d.; electric bells, 4s. 9d.; electric bell gongs, 1s. 3d.
H. G. Mayer & Co., 105-volt 16-C.P. lamps, 4½d.; 150-volt 20-C.P., 5½d; 250-volt 16-C.P., 6½d.
Trolley poles and accessories.—Consolidated Accessories Co., Ltd., trolley poles, 14 ft. 6 in., 18s. each.
Estler Bros., steel balls, ¾ in., 4s. per gross; 6-in. race rings, 9s. 6d. each.
Castings.—Thornton & Crebbin, Ltd., brake shoes, £10 per ton.
Mountain & Gibson, Ltd., horn blocks, £3 15s. each; axle boxes, £1 10s.; ditto, lids, 3s.; sand hopper castings, £1 10s. per set; life guard castings, £3 17s. 6d.; trolley standards and bases, £5 5s. each; rocking arms and caps, £2 each; springs, 8s.; radial truck controlling gear castings and springs, £8 per set; adjusting axle collars, £1 5s. each; axle box bearings, 15s. each.
The Malleable Steel Castings Co., Ltd., motor and armature bearings, armature pin end, £1 2s. 6d. each; commutator, 15s.; motor sec. half, 12s. 6d.
Wm. Wood & Co., patent metal for bearings, 9d. per lb.
Cables and wires.—General Electric Co., Ltd., 7/16 cable, £3 12s. per 110 yds.; 7/20 cable, £1 10s.; 3/22 cable, 15s. 6d.; electric bell wire, 2s. 3d.
Controllers.—British Westinghouse Co., fingers, 8d. each; contacts, drum rings, 1s. 3d.; contacts, arcing tips, 4d.; power cylinders, £6 10s.; handles, main drum, 12s.; handles, reverse handle, 4s. 6d.; reverse drums, No. 1, 12s. 9d.; motor cut-outs, No. 2, 12s.
Cable connectors.—British Westinghouse Co., automatic circuit-breaker, £3 3s. each; canopy switches, £1 10s.; resistance boxes, Nos. 1 and 2, £4; Nos. 3 and 4, £2 5s.
Motors.—British Westinghouse Co., carbon brush holders, £2 2s. each; pinion wheels, 8s. 6d.; gear wheels, £2 18s. 6d.
Trucks.—Mountain & Gibson, Ltd., truck springs, car body, 10s. 6d. each; truck springs, end of frame, 12s. 6d.; brake brackets, £1 18s. per set; axle box springs, 5s. 6d.; release springs, 4s.; brake links and pins, £2 8s. per set; bell gong punches, 18s. per doz.; bell gongs, 5s. each; punches, 18s. per doz.
Asbestos and insulating material.—Consolidated Accessories Co., P and B tape, 1 in. wide, 1s. 3d. per lb.; asbestos sheet, 8d. per lb.
General Electric Co., Ltd., mica best clear, insulating, 3s. per lb.; vulcanite fibre, ⅛ in. thick, 10d.; ¼ in. thick, 10d.; voltalac, 9s. per gal.
W. T. Henley's Telegraph Works Co., Ltd., pure para strip, ½ in. wide, 7s. 9d. per lb.
Armature repairing materials.—General Electric Co., Ltd., linen frame tape, 1 in., 7s. per lb.; linen tape (grey), ½ in., 9s.
British Westinghouse Co., Ltd., mica cones, 7s. each; ditto. 12s. 6d. per lb.

On schedules of prices, the tenders of the following were accepted for the articles named:—

Glass.—Consolidated Accessories Co. and Mountain & Gibson, Ltd.'
Tinware, &c.—Consolidated Accessories Co.
Oils.—Theo. Phillips, Son & Co. and Palmer & Co., Ltd.
Lubricating oils.—Alex. Duckham & Co., Ltd., and Palmer & Co., Ltd.
Iron and brass stanchions.—Mountain & Gibson, Ltd.

The tender of Messrs. Venner & Co. for the annual supply of meters was accepted at the following rates:—

Size 1½ amp., £1 13s.; size 3, £1 16s.; size 5, £2; size 10, £2 5s.; size 25, £2 10s.; size 50, £2 14s.; size 100, £3 3s. Slot meters, size 1½, £2 15s.; size 3, £2 17s. 6d.; size 5, £3.

London.—SOUTHWARK.—The B.C. received the following tenders for an electrically-driven boiler feed pump at the generating station:—

Mather & Platt, Ltd.	£325	Hayward, Tyler & Co., Ltd.	£271
Merryweather & Sons, Ltd.	318	Do. (alternative)	311
Do. (alternative)	235	Haste Pump Co., Ltd. (accepted)	245
Nichols Bros.	295	Clarke, Chapman & Co., Ltd.	241
Electric Construction Co., Ltd.	284	Isaac Storey & Sons, Ltd.	232
Do. (alternative)	299	Worthington Pump Co., Ltd.	213
E. Scott & Mountain, Ltd.	271	Johnson & Phillips, Ltd.	209
Do. (alternative)	341	British Westinghouse Co., Ltd.	195
General Electric Co., Ltd.	268	F. Pearn & Co., Ltd.	195

WOOLWICH.—The B.C. has received the following tenders for stoneware ducts 4 single-way:—

Albion Clay Co., Ltd.	3s. 11d. per yard.
Denington Sanitary Pipe and Fire Brick Co., Ltd.	2s. 10d. per yard.
Doulton & Co., Ltd. (accepted)	2s. 9d. per yard.

FULHAM.—The B.C. Electricity Committee has accepted the tender of Messrs. Edgar (the lowest received) for the supply of 135 Nernst lamps and fittings, at 35s. 6d. each.

L.C.C.—The Highways Committee of the L.C.C. has received the following tenders for Greenwich station:—

1.—COAL AND ASH CONVEYORS.

Spencer & Co.	(recommended)	£2,314
New Conveyor Co.		2,547
R. Dempster & Sons		3,554

2.—OIL TANKS AND FILTERS.

Shelby & Co.	(recommended)	£423
S. Russell & Sons		654

3.—WIRING MATERIAL FOR SUB-STATIONS.

General Electric Co.	(recommended)	£375
Edison & Swan Co.		379

The tender of the Electric Construction Co., amounting to £375, has been accepted for the supply of rheostat grids for the tramways department. Four firms submitted tenders for heavy machine tools, required for the central car repair depôt. The tender of Buck and Hickman, Ltd., is the lowest in each case, and is proposed for acceptance for (1) two motor-driven tire-turning lathes, and (2) two high-speed 8½ in. S.S. and S.C. lathes, amounting to £2,288. It is proposed to invite fresh tenders for two high-speed vertical tire-boring mills, and one high-speed vertical milling machine, as the offers received are not considered to be satisfactory. The tender of the Standard Engineering Co., amounting to £566 13s. 6d., is to be accepted for the delivery of smiths' shop equipment for the car repair depôt. Three other firms sent in offers for the contract. The undernoted firms submitted tenders for wiring and fittings, bells and telephones at the Central School of Arts and Crafts in Holborn:—

Mercer, Rance & Co.	£2,025	J. O. Grant & Taylor	£2,821
W. Barton & Sons (recom.)	2,120	Cox-Walkers, Ltd.	2,854
C. C. Pudney	2,480	Aberdeen Elec. Engineering Co.	2,918
Pinching & Walton	2,496	S. G. Cozens	3,128
Vaughan & Cook	2,525	F. A. Glover & Co.	3,150
Beaven & Sons	2,700	W. G. Cannon & Sons	3,199
H. J. Galliers	2,714	D. Hulett & Co.	3,294
F. Suter & Co.	2,767	Barlow Bros. & Co.	3,466

The firm who submitted the lowest tender have asked to be allowed to increase the amount by £300, on account of the omission of two provisional amounts of £150 each. As a consequence, the second tender on the list becomes the lowest, and is proposed for acceptance.

Luton.—The T.C. has accepted the tender of Messrs. John Wilson & Co., of 49, Lime Street, E.C., for pipe work, &c., at the generating station, at £647.

Middlesex.—The County Council has accepted the tender of the Cleveland Bridge Co.—at £5,805—for the reconstruction in connection with tramway No. 8, of the bridge over the London and North-Western Railway at Willesden Junction. The tender was the lowest received.

Paisley.—Messrs. Bruce Peebles & Co., Ltd., have received a repeat order from the Corporation for a 750-KW. high-tension alternator.

Rio de Janeiro.—The Empire Roller Bearings Co., Ltd., have received a further order for 380 axle-boxes and spare parts for the Rio tramways, thus making over 600 axle-boxes supplied to this one company for their tramcars.

Rochester.—The T.C. has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for the construction of the permanent way of the extension of the tramways, at £33,569, and also for the overhead equipment, at £3,418.

Rugby.—The U.D.C. has accepted the tender of Messrs. W. T. Henley's Telegraph Works Co. for the supply of service cable.

Wednesbury.—The Corporation has accepted the following tenders:—

Phœnix Dynamo Manufacturing Co., Ltd., for the supply and erection of balancer, boosters and switchgear.
Tudor Accumulator Co., Ltd., for a battery of accumulators.

FORTHCOMING EVENTS.

Wednesday, July 31st to August 7th.—Annual meeting of the British Association for the Advancement of Science, at Leicester.
Saturday, August 3rd.—At 2 p.m. Annual meeting of the North of England Institute of Mining and Mechanical Engineers.

NOTES.

Educational Note. — The University of Manchester announces that the session in Electrical Engineering commences on October 1st. The subject may be included in the course for the B.Sc. degree. See "Official Notices" to-day.

Appointments Vacant. — Engineering draughtsman (temporary) for the Stepney electric lighting department (£5), to prepare plans in connection with the erection of a riverside electricity generating station. If suitable, he will be required to act as clerk of works during construction. Leith: station superintendent for the Corporation (£91 and house). Uganda: electrical mechanician for the Uganda Protectorate Government (£200 and free quarters). George Town, Penang: assistant engineer for tramway ($250 per month, say £20).—See "Official Notices" to-day.

A New "Couple" Type Storage Battery.—For the particular work of fire-alarm telegraphs and similar installations, the "couple" type of storage battery, which consists of a single pair of plates in each cell, has been found particularly advantageous, as but small ampere capacity is needed for this class of service, while a low rate of discharge, accessibility of parts, and especially absolute certainty of action are essential. For this service the Gould Storage Battery Co. has devised a new type of cell. Necessarily, the action between the positive and negative sides of storage battery plates which face each other is far more intense than between the sides turned away from each other, so that charge and discharge take place mainly on the facing sides, producing a tendency to buckle and wear unevenly. To eliminate these defects, the plates in the new type are placed edge to edge instead of face to face. As all parts of both sides of both plates are exposed to exactly the same conditions of acid supply and exposure to the electrolyte, charge and discharge proceed at the same rate in every part of the grid, which, owing to its peculiar "spun" construction out of hard-rolled integral lead, and its proportions of reserve lead base to active material, will, it is claimed, retain its original capacity and shape intact for many years, no part giving way until the whole plate all over gives out by complete consumption. The positive plate of each cell is permanently joined to the negative plate of its neighbour by broad substantial curved lead bonds, "burned" to the plates, so that no bolts are used except at the end of each row of cells. This permanent connection saves considerable time and trouble in assembling the battery, enables the plates to be quickly lifted out for inspection as well as for cleaning the cell, and avoids corrosion of bolted connections by sulphuric acid fumes, besides having practically negligible ohmic resistance. This construction also presents other advantages, such as low internal resistance, low first cost, accessibility for inspection, and absolute reliability of operation for use in fire-alarm and police telegraphs.—*Electrical World.*

Accidents Due to Electricity in Switzerland in 1906.—*L'Industrie Electrique* states that 35 persons were injured in 1906, compared with 30 in 1905, and of these, 9 were killed, against 2 in 1905. Of the total, 25 were officials, and 10 were unconnected with the industry; more than half the cases were due to imprudence. One death took place on a 220-volt D.C. circuit, and 29 per cent. of the accidents occurred with pressures below 250 volts.

The Metric System in America.—*L'Industrie Electrique* quotes a letter published in an American paper relating to the construction of 20 locomotives in the Baldwin works to French designs, the drawings being figured in metric units, and numbering 500, there being more than 10,000 separate parts. The Baldwin works put these drawings in the hands of artisans who were not accustomed to the metric system, and the work was carried through with the same facility as though English units had been employed, with even fewer errors, and without confusion, although drawings figured in English measures were simultaneously in use in the same shops.

Wire Accident.—At Chinchpoogly, Bombay, early in July, a telephone wire broke and fell across a tramway wire. Two horses were killed on the spot by shock.

Electro-Medical Papers at Exeter.—In the Electrical Section of the British Medical Association at Exeter this week an address was given by Prof. Stephane Leduc. The following papers were down to be read:—Dr. Delpratt Harris, "Some Statistics of X-Rays Therapeutics in Rodent Ulcer and Carcinoma;" Prof. Wertheim Salomonson, "The Einthoven Galvanometer;" Dr. Lewis Jones, "Oscillograph Tracings of Medical Coil Currents;" Dr. J. Goodwin Tomkinson, "A Method of Treating Lupus Vulgaris;" Dr. W. F. Somerville, "The Effects of High Frequency Currents on the Urinary System;" Dr. Hugh Walsham, "The Orthodiagraph. Lantern demonstration." Discussion on "X-Rays and Sensitive Plates," opened by Mr. Mackenzie Davidson, Dr. Orton and others to speak. Dr. Ellis Pearson, "The Use of the X-Rays from the Point of View of the General Practitioner;" E. W. H. Shenton, M.R.C.S., L.R.C.P., "The Examination of the Hip Joint;" Dr. J. R. Riddell, "The Measurement of the Brim of the Female Pelvis by Means of the X-Rays;" Dr. Howard Pirie, "A new Meter for Measuring the Currents through an X-Ray Tube and Measurement of the Reverse Current passing through an X-Ray Tube;" Prof. Wertheim Salomonson, "The Electro-Diagnosis of Oculo-motor Paralysis;" Dr. Taylor, "A Case of Paget's Disease treated by X-Rays" (Microscopic Specimens). Lantern demonstration. Discussion on the Dosage of X-Rays opened by Dr. Sequeira. Dr. Howard Humphries, "The Rationale of Static Currents;" Dr. R. Morton, "Alternating Currents of Slow Periodicity;" Dr. A. Reid, "Ureteral Calculi;" Dr. Ironside Bruce, "Systematic Radiography;" Dr. Stanley Green, "X-Rays and Chest Disease;" Dr. D. Arthur, "A new Static Machine."

Competition.—The City of Geneva has opened a competition for the best project for the utilisation of the water-power of the Rhone at la Plaine, below the Chèvres electricity works. The fall here is 12 to 13 m., and the available flow varies from 120 m.³ in winter to 600 m.³ in summer. The generators must give two-phase currents at 5,000 volts, 48 cycles per second; the pressure will be raised to 20,000 or 25,000 volts for transmission to a distance. There will be 10 or 12 main generators with vertical shaft turbines, the latter being arranged with two runners, of which only one will work with low water. The scheme must include the general lay-out, as well as the hydraulic works and power station. Particulars can be had from the Conseil Administratif de la Ville de Genève, on deposit of 20 fr., and the projects must be delivered before the 31st inst. The sum of 20,000 fr. will be distributed in prizes for the best designs.

London's Power Supply.—In last week's issue of the Engineering Supplement of the *Times*, Mr. H. B. Renwick, the general manager and secretary of the County of London Electric Supply Co., took up the cudgels on behalf of the existing London electric lighting companies and refuted statements made in a previous issue by the writer of an article on the subject. Among other things, Mr. Renwick says:—

"Your correspondent's statement that the average rate for power in London is nearly 2d. per unit is incorrect. The average of the actual rates obtained during the past year by the whole of the supply companies in London was 1·4d., while the average rate obtained by the borough councils for power was below that figure. As a matter of fact, current for industrial power purposes is actually being sold in London at the same rate as that quoted by your correspondent as an instance of the low rates granted in other parts of England, but in drawing a comparison between the rates in London and those in manufacturing districts in the North, your correspondent omits to point out that while the largest factories are to be met with in the latter case, the average user in London does not exceed 8 H.P. If the rates charged to small consumers in the North are compared with those in London under similar circumstances, it will be found that the rates for supply in London compare favourably with those elsewhere, in spite of the difference in coal costs. Of the total power requirements of London for manufacturing purposes, the existing undertakings are supplying over 35 per cent., and not 10 per cent. as stated by your correspondent. The average price of electricity for all purposes for the past year was not over 3d. per unit, but was 2·84d. Your correspondent infers that the existing undertakers are practically lighting companies only, which is not the case—for instance, my company supplied 44 per cent. of its total output for power purposes in 1906 and for last quarter it was 58 per cent. Your correspondent states that the consumption of electric energy per head in London is only one-twelfth of that on the Tyne. The evidence produced before the Hybrid Committee in the present Session of Parliament showed that the consumption in London averages 50 units per head, while for Newcastle and district the consumption averaged 58 units per head."

The statement said to have been made by a deputation of manufacturers to Mr. Bonar Law, M.P., that there would have been a saving of £3,000,000 per annum in London factories "is a gross and absurd exaggeration. The figure here mentioned is far greater than the total amount at present expended annually on industrial power supply in London for all purposes."

"The statement that the existing undertakings, both municipal and company, are spending over £1,000,000 annually in extending systems largely obsolete is a further typical misstatement. Any one acquainted with the facts is well aware that the major portion of the capital invested in the London undertakings has been expended upon the laying of mains to supply the existing demand both for power and lighting, which mains none of the schemes brought before Parliament proposed to supersede; and, further, that recent expenditure upon machinery and plant has resulted in bringing the equipment of London stations thoroughly up to date, with large generating units of the same type as those advocated by the promoters of the schemes referred to.

"Both before Parliament and in the Press, the extent of the demand for power in London has been grossly exaggerated, and the supply given by the existing undertakers has, on the other hand, been systematically minimised and understated. It can be proved that, as already stated, over 35 per cent. of the power demand in London is being supplied by the existing undertakers, and that the demand is being well met by the companies and the local authorities, both of whom are in a position to deal efficiently with any demand for manufacturing purposes that may arise. Taking the County of London Electric Supply Co. as an example of what has been done to meet the demand for power supply in London, I may mention that that company has secured over 75 per cent. of the power users in its areas, and is daily reducing the outstanding number. Other undertakers can show a similar result."

British Association.—In our issue of July 19th, we gave a first list of papers to be read before the Engineering Section. The following are also included in the revised programme:—

Sir Oliver Lodge, on "Tuning in Wireless Telegraphy."
W. Worby Beaumont, on "The Origin and Production of Corrugation in Tramway Rails."
C. V. Drysdale, on "Resistance Coils and their Comparison."

Electrical Production of Nitric Acid.—Herr A. Neuburger, of Berlin, has taken out an American patent for an electrical process of making nitric acid from the atmosphere, by the aid of which he claims to be able to prepare a nitric acid uncontaminated with nitrous acid. The essential feature of the process is that the electrical discharges are obtained from a current of less than 120 watts. The inventor states that the proportion of nitrous acid in the nitric acid usually obtained is a function of the wattage of the original current; for instance, the secondary current obtained by suitable transformation of a primary of 200 watts gives a mixture containing equal parts of nitric and nitrous acids. If the current is about 150 watts, the yield contains about 30 per cent. of nitrous acid; if the wattage is 120 the nitrous acid falls to 18 per cent., and if it is still further reduced pure nitric acid is said to be obtained.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Bexley U.D.C. has appointed Mr. GEO. KENT, of the Potteries Electric Tramway Co., as engineer's assistant at the electricity works.

The salary of Mr. R. JONES, chief assistant at the U.D. Council's electricity works, Dartford, has been increased from £100 to £130 per annum with house, coal, light, &c.

Mr. C. E. D. GREENHALGH, assistant station superintendent at Wakefield electricity works, was appointed working assistant to the Malvern U.D.C. on Tuesday.

Mr. WALTER KIDNER, who has resigned his position as chief assistant to the Leatherhead and District Electricity Co., Ltd., to take up a similar appointment under the Horsham Urban District Council, was presented, on leaving, with a pair of framed photographs, tobacco pouch and pocket-book by his late colleagues.

General.—We are informed that Mr. L. E. WOOD, late of West Hallam Collieries, has been appointed chief electrician at the Butterly Coal and Iron Co.'s Langley Collieries, Heanor, and takes up his duties on August 7th.

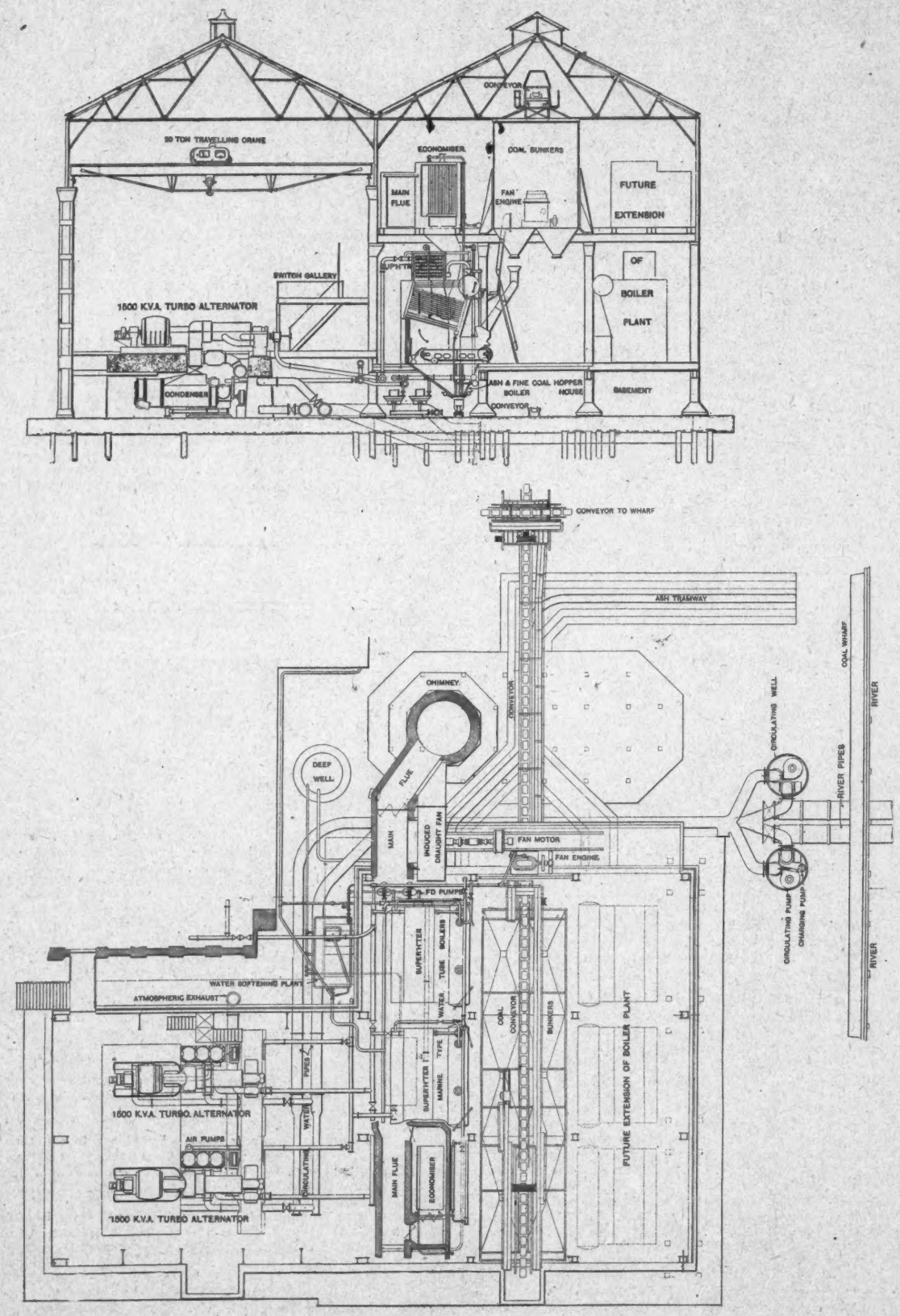
It is announced that the Lords Commissioners of the Treasury have appointed Sir HENRY W. PRIMROSE, K.C.B., C.S.I., to be Chairman of the Pacific Cable Board, in succession to the late Sir Spencer Walpole, K.C.B.

Mr. H. E. BRAIN, formerly electrical engineer to the Buenos Ayres and Pacific Railway, who is now in London (at 44, Bernard Street, Russell Square, W.C.) will be glad to hear from English manufacturers of electrical and other machinery desirous of being represented in the Argentine Republic.

Mr. MAURICE GRAHAM informs us that he has, as from July 15th, resigned all his interest in the firm of Messrs. Graham, Morton and Co., engineers and contractors, Leeds, he having decided to devote the whole of his time to his consulting work in the special study of the transmission and handling of materials by labour-saving machinery. On October 19th Mr. Graham leaves England for a 12 months' tour round the world, and he intends inspecting the latest methods of labour-saving machinery for handling heavy materials. On his return to London in October, 1908, he will establish his office in Westminster. Mr. C. A. Goodall and Mr. W. B. Leech (both of whom have been with Mr. Graham for the past ten years) have taken over and will carry on the business of the Leeds firm.

Mr. W. E. POOLE has left the Hexham and District Electric Supply Co., Ltd., and taken up a position on the Construction Staff of the Cleveland and Durham Electric Power, Ltd.

The staff of the British Aluminium Co., Milton, have presented a dressing case to Mr. W. F. ANGEL, the company's electrician, who is leaving to take up a position at Chicago.



FIGS. 1 AND 2.

SECTIONAL ELEVATION AND PLAN OF THE NEW TURBO-GENERATING PLANT OF THE SOUTH METROPOLITAN ELECTRIC LIGHT AND POWER CO., LTD.

Being the first completed section of the proposed Plant on the Company's East Greenwich site.

THE NEW POWER STATION OF THE SOUTH METROPOLITAN ELECTRIC LIGHT AND POWER CO.

While the object of the present article is to illustrate the modern turbine station recently erected by the South Metropolitan Co., as a first instalment of the large power plant which it is hoped may ultimately find a place on the company's East Greenwich site, we may with advantage refer briefly, in the first place, to the general question of power supply in London.

As our readers are well aware, recent events have practically shelved this question for the present, although one of the schemes—that which was put forward by the London companies in combination—had much to recommend it.

It would, by utilising existing plant and business organisations, have enabled an initial supply to be given immediately, and, so soon as the necessary arrangements were completed, a supply of the cheapest character, produced under the most advantageous conditions, could have been provided. It is in this connection that interest attaches to the new power station of the South Metropolitan Co., as its situation on the Thames below Greenwich gives it all the advantages of cheap coal, water, and buildings, ease of extension, and freedom from vibration or smoke trouble, points which Mr. H. W. Bowden, the managing director and engineer-in-chief to the company, under whose supervision the work has been carried out, has made the fullest use of in the initial plant recently completed. Primarily, of course, this plant will supplement the company's older stations in supplying their area, the older plants carrying the "peak" load.

As is probably well known, the South Metropolitan

Fig. 3.—The East Greenwich Site of the South Metropolitan Electric Light and Power Co., Showing the New Power Station on the Right.

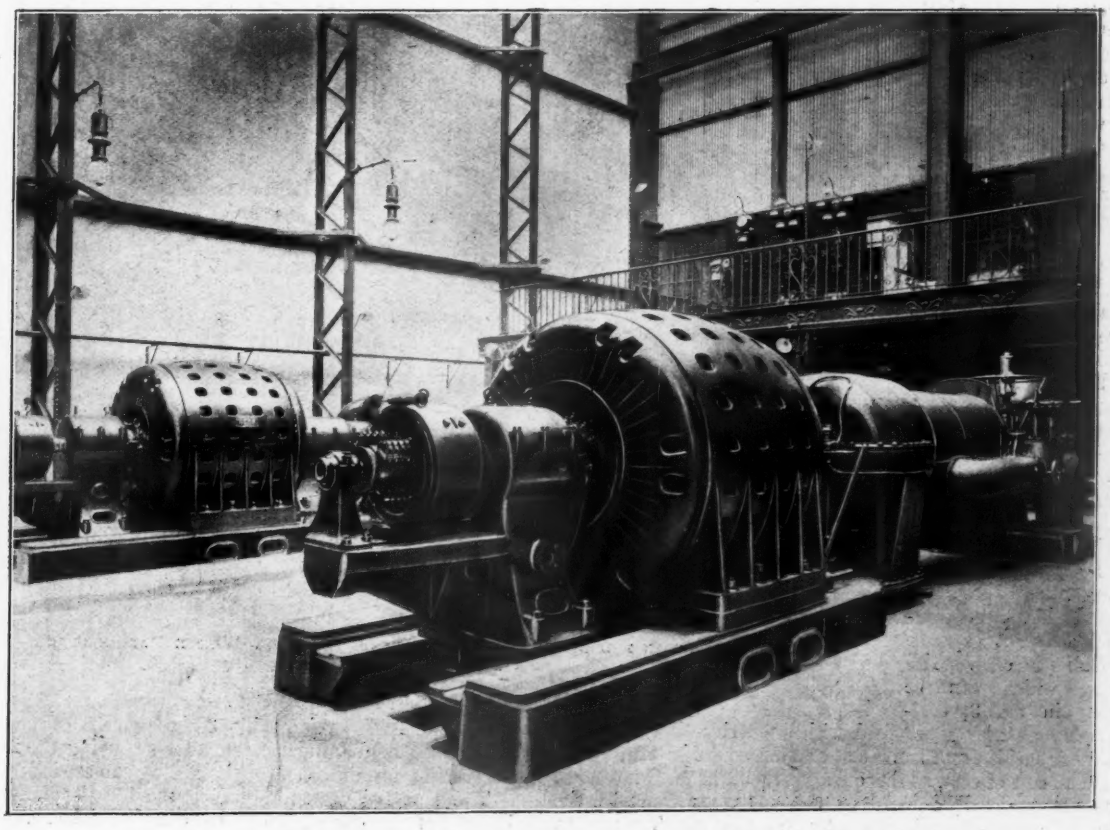


Fig. 4.—The Engine Room; Willans-Dick, Kerr Turbo-Alternator Plant.

Electric Light and Power Co. originated in the Blackheath and Greenwich District Electric Light Co., which dates back to 1896. The area of supply has from time to time been extended by absorbing adjoining districts and the acquisition of the undertaking of the Crystal Palace and District Electric Light Co., until it now extends without interruption from the River Thames in the north to Beckenham and Bromley in the south, and from Woolwich in the east to Deptford, Camberwell and Croydon in the west, covering nearly 30 sq. miles. Furthermore, under its 1903 Parliamentary powers the company is able to supply any adjoining supply authority working under statutory powers, also tramways.

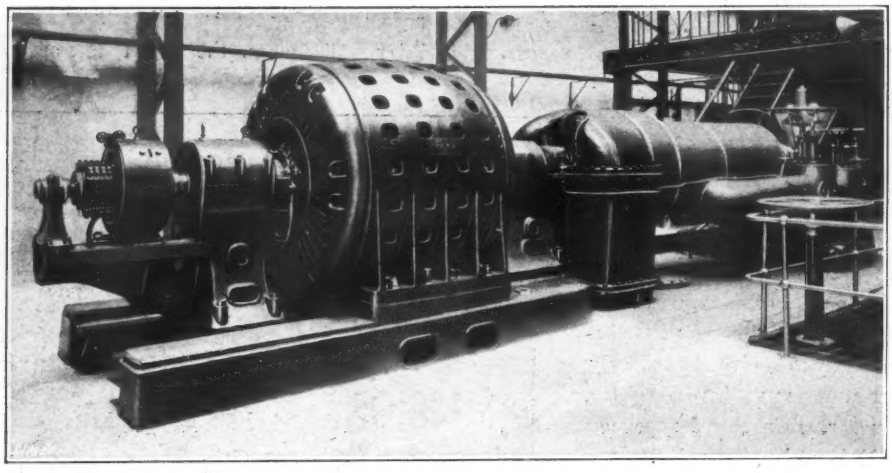


Fig. 5.—Willans-Dick, Kerr 1,500 k.v.a. 3-phase Generating Unit.

The company's area is, of course, largely residential in character, yet in both Greenwich and Charlton it possesses valuable manufacturing districts, where the use of electrical power is steadily increasing; and in view of this and the possibility of larger schemes for the general supply of cheap electricity for all purposes in the London area, the company's initial and proposed power plants at Greenwich are of more than ordinary interest.

Fig. 16, p. 185, shows the proposed lay out of the complete scheme which embraces a north wing containing 10,000 KW. of plant, and a south wing containing 22,000 KW. The plant, as proposed, would have a continuous overload capacity of 25 per cent. The site, which can be seen in fig. 3, comprises some 2½ acres of land with good river frontage; and further facilities for storage of coal of about 1½ acres.

The cost of coal, as the quantity to be handled increases, may be eventually reduced by about 1s. per ton, with the help of a deep-water jetty and 2,000-ton ships. The present cost of transferring coal from barge to bunker is about 1½d. per ton.

The initial installation (a portion of the future north wing) includes two 2-phase 3,000-volt 1,500-KW. turbo-generator units; it is proposed to extend, by adding two 3-phase 10,000-volt 3,500-KW. turbo-generator units, to complete the north wing, and later again, by adding a south wing containing four 3-phase 10,000-volt 5,500-KW. turbo-generator units, the scheme including six banks of Marine type water-tube boilers (comprising 30 boilers in all), with six induced draught plants and chimneys, auxiliary plant, &c.

With the modern construction employed, the capital cost of the initial installation has been in the neighbourhood of £13 per KW., and as this includes a considerable capital expenditure on buildings and plant, which will not be fully utilised until additional generating plant is installed, it is evident that the average cost per KW. will be still smaller in the future.

At the present the company generates and transmits to its sub-stations, two-phase alternating-current, at 3,000 volts pressure and 50 cycles, but with larger units and heavier transmissions, it is intended to increase the transmission pressure to 10,000 volts, using 3-phase generators and Scot connected step-down transformers for supplying the 2-phase distribution from the company's existing sub-stations.

The new buildings for housing the initial plant, as will be seen from our plan of the complete scheme, are in close proximity to the original station of the company, and being situated right on the bank of the river, their construc-

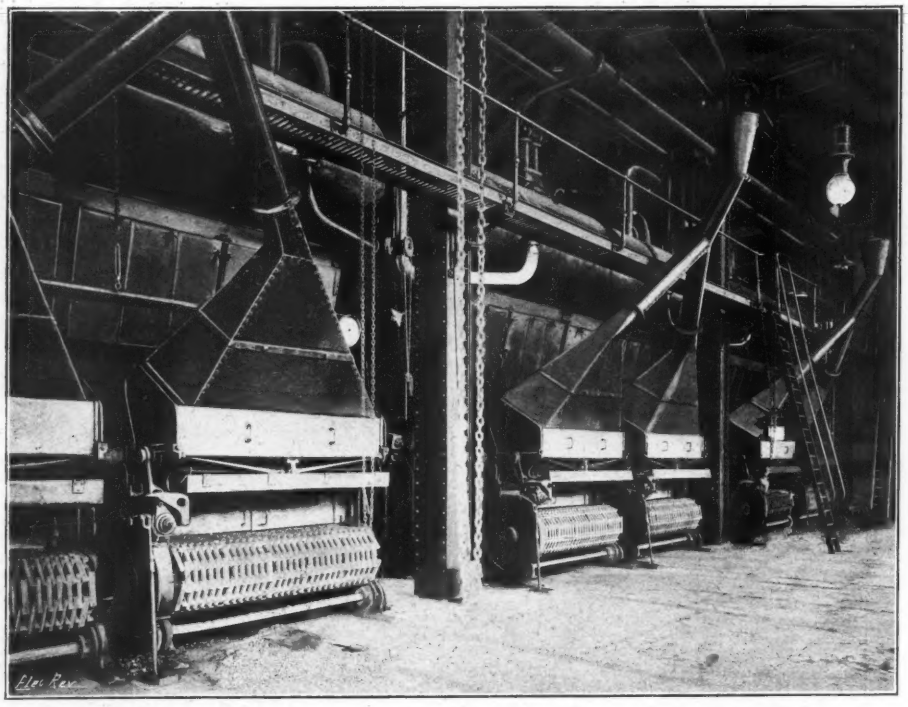


Fig. 6.—View in the Boiler House, Showing Babcock and Wilcox Marine Type Water-Tube Boilers.

tion naturally involved some foundation troubles. The latter were overcome by piling, 12-in. pitch pine piles, varying in length from 24 to 30 ft., being employed for supporting a concrete foundation float, 3 ft. thick, on which the station structure stands.

The main building is somewhat unique in construction, in this country at least, as it consists of a steel framework filled in with reinforced concrete for the permanent walls, expanded metal being employed for the reinforcing, both for walls and floors. This system of construction, combined with the substantial character of the steel-work employed, has enabled the designers to produce an exceedingly compact power plant, with, however, superabundant space where required. The main buildings, which cover 118 ft. × 116 ft. of ground, and are 40 ft. in height to the eaves.

The boiler house plant, as will be gathered from the cross-section, fig. 1, is of modern type, and includes a bank of three Babcock & Wilcox Marine type water-tube boilers, which occupy one side of the building, as shown in fig. 6, and will eventually be duplicated by the installation of similar boilers on the opposite side of the central firing floor.

Each boiler has a normal evaporative capacity of 20,000 lb. of water per hour, at the working pressure of 200 lb. The overload capacity in each case is upwards of 25,000 lb. per hour. The boilers are fitted with improved chain-grate stokers, driven through shafting by a 7½-B.H.P. B.T.-H. induction motor; Babcock Wilcox superheaters are also fitted, designed to give a superheat ranging up to 200° F.

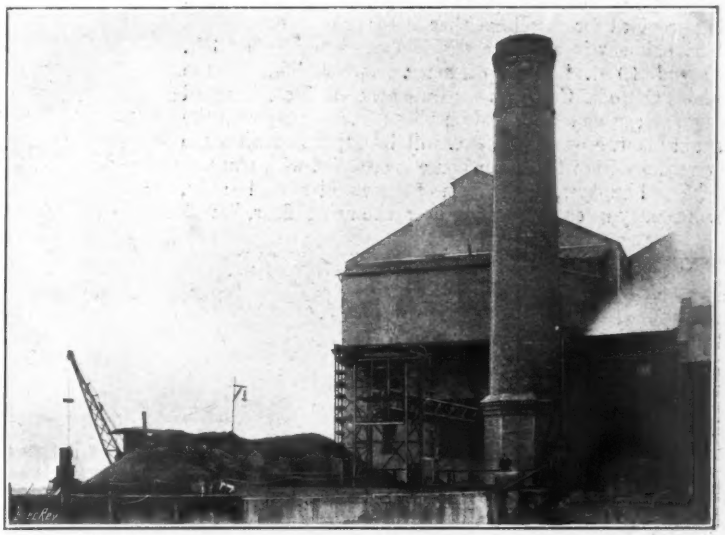


Fig. 7.—Showing the Coaling Quay and Conveyor to the New Plant.

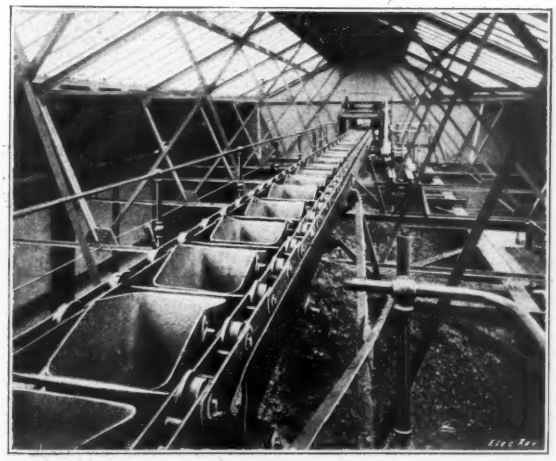


Fig. 8.—The Conveyor and Driving Gear over the Coal Bunkers.

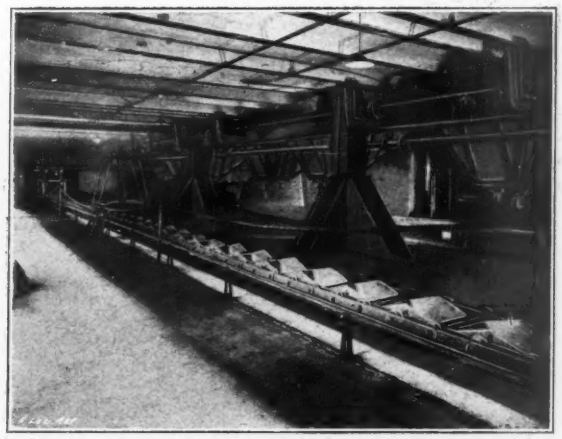


Fig. 9.—View in the Boiler House Basement, Showing the Conveyor, Ash Hoppers, &c.

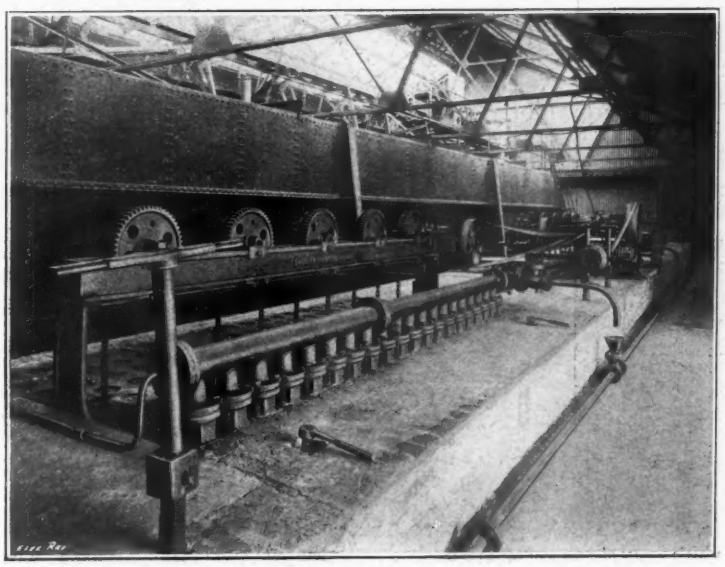


Fig. 10.—The Boiler House; View of the Economisers and Coal Bunkers.

Above the boilers, supported on massive stanchions, is a second floor, which carries the main flue, economisers, coal bunkers, &c., as illustrated in fig. 10.

The boiler gases discharge upwards through steel uptakes into three Green economisers, each containing 160 tubes, and through the latter into a horizontal flue of brick and concrete construction, leading into a stack at the western end of the building. At the side of the flue in the boiler house, a Musgrave induced draught fan is installed, the gases discharging through an elevated steel flue into the stack. The economiser scrapers are operated by a 3-B.H.P. B.T.-H. induction motor; the draught fan which has a capacity of 125,000 cb. ft. per min. at a temperature of 500° F., and is capable of maintaining

a suction draught of 2 in., is normally operated by a 90-B.H.P. B.T.-H. induction motor running at 240 R.P.M. (fig. 14.); it may, however, in emergency, be driven by a two-crank Sentinel high-speed engine to which it is coupled by chain drives through a counter-shaft, claw clutches being provided for coupling either motor or engine.

The chimney is a comparatively short stack some 86 ft. high and 10 ft. internal diameter. It was built by the Alphons Custodis Co. on a separate concrete float, designed for two stacks, and supported on piles; it, together with the draught plant, economisers, &c., will be duplicated when the now vacant side of the boiler house is occupied with plant.

The coal bunkers, in the form of rectangular steel tanks, which occupy a central position over the firing floor, have a

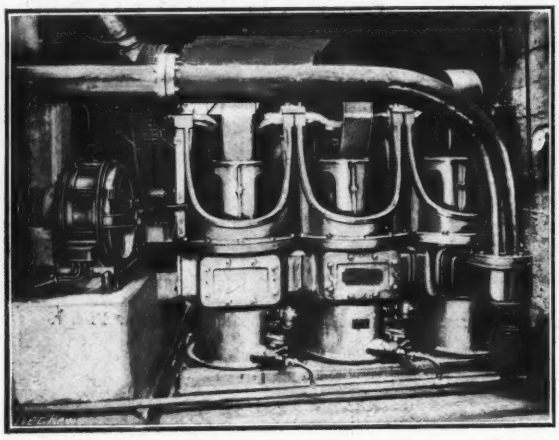


Fig. 11.—Mirrlees-Watson Air Pumps, Main Condensing Plant.

capacity of 600 tons, coal being fed through chutes into the stoker hoppers below. The fuel supply to the station is obtained from barges moored alongside the company's wharf;

Fig. 13.—The Boiler House; Weir Feed Pumps in the Basement.

grab cranes transfer the coal into the hopper of a Babcock and Wilcox gravity bucket-type conveyor, which serves the company's original boiler plant, and by means of an intermediate filling hopper (shown in our view, fig. 7) serves a similar conveyor running at right angles, which passes up over the coal bunkers in the new boiler-house and returns

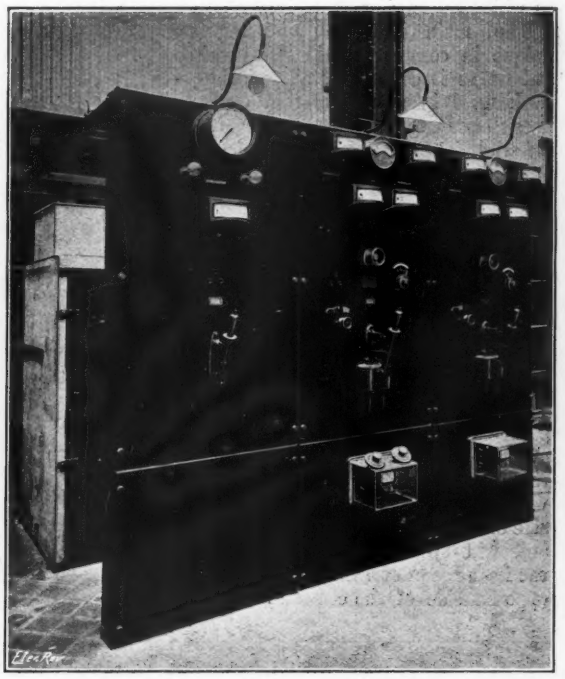


Fig. 12.—The Generator and Interconnecting Switch Panels.

through the basement in the usual way. The conveyors have a capacity of 20 tons per hour; a conveyor is shown, together with the driving gear, in fig. 8. It is electrically

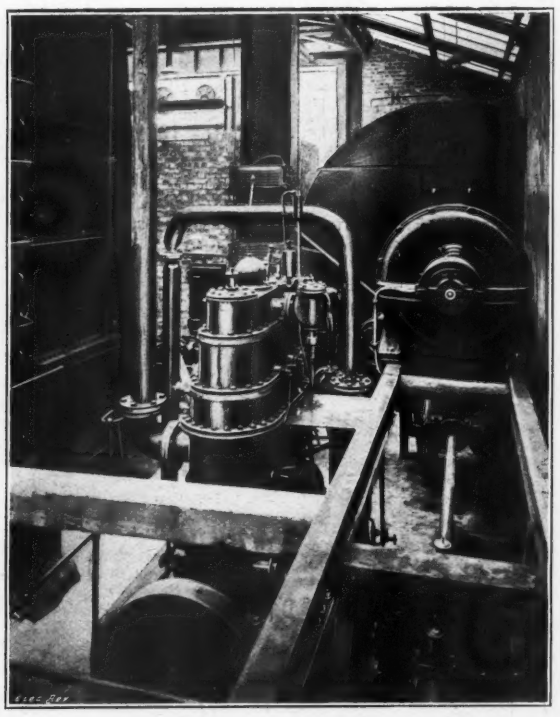


Fig. 14.—The Boiler House; View of the Induced Draught Fan and Driving Gear.

driven by a 5-B.H.P. B.T.-H. induction motor, and carried on the steelwork of the bunkers. The conveyor does not deal with the ash discharged from the furnaces, special

divided hoppers being provided for this purpose in the basement, which empty into tip trucks running on an 18 in. gauge track. The hoppers are arranged so that one half receives the ash carried over the rear of the chain grate, and the other the fine coal which falls through the grates; the ash is carried away to the wharf for disposal, and the fuel returned by the conveyor to the bunkers.

Fig. 9 gives a good idea of the spacious basement in the boiler house, also showing the ash hoppers and conveyor;

FIG. 15.—DIAGRAM SHOWING THE SOUTH METROPOLITAN CO.'S AREA AND ADJOINING SUPPLY AUTHORITIES.

and fig. 13 shows the two single-cylinder Weir boiler feed pumps, automatic in action, installed in one corner of the basement, but in sight of the boiler attendants on the floor above.

The feed pumps are each of a rated capacity of 10,000 gals. per hour; they draw from a large hotwell situated near by in the basement, and feed normally through the economisers to the boilers. The feed piping is of solid-drawn steel; an auxiliary steam connection to one of the boilers and the steam range serves the feed pumps.

The general water supply for the station is pumped from an Artesian well, 300 ft. deep and 8 in. bore, into a storage tank; the well yields 10,000 gals. per hour, and supplies any make-up water required for the hotwell. The latter supply is first treated in a Lassen and Hjort softener with a rated capacity of 2,000 gal. per hour, located outside the building.

To provide against emergencies, the Metropolitan Water Board's public supply is laid on to the plant.

The steam-piping connecting the boilers with the turbo-generators installed in the engine house is of solid-drawn steel, and consists of 6 in. dia. boiler branches leading downwards into a 10-in. dia. header in the basement, which latter is coupled to the turbines by 8 in. dia. branches; also to the steam range in the adjacent station through an Auld's full bore reducing valve.

The turbo-generators, two of which are installed, are of the Willans-Dick, Kerr type, the leading features of which were described in the ELECTRICAL REVIEW of June 7th last; they rest on solid concrete pillars.

Each unit is of 1,500 K.V.A. output, generating two-phase current at a pressure of 3,000 volts and 50 cycles, the normal speed being 1,500 R.P.M., and is designed to carry an overload of 25 per cent. continuously and 50 per cent. for a period of two hours. Views of this plant are given in figs. 4 and 5.

A small 50-volt exciter is mounted on an extension of the generator shaft in each case. Each turbine exhausts direct into a surface condenser, installed immediately below in the basement, and containing 4,600 sq. ft. of cooling surface; the condensed water and vapour is drawn off by a three-throw air-pump gear driven from an 18-B.H.P. B.T.-H. induction motor, and pumped into the hotwell.

The condensing plant was supplied by the Mirrlees Watson Co., and is guaranteed capable of maintaining a vacuum of 28½ in. at full load with circulating water at a temperature of 60° F.

The usual alternative exhaust to atmosphere, through an automatic valve, is provided to each turbine; the condensers are in each case supported on helical springs, which allow of their adjusting themselves to any expansion or contraction of the turbine and condenser castings, this arrangement being adopted with a view to avoiding possible distortion of the turbine barrel.

Circulating water for the condensers is obtained from the river, and special arrangements have been made to avoid the carrying over of mud and sediment, which might otherwise choke the condensers.

Two 8-ft. diameter cold water river wells, built of cast-iron segments, have been sunk on the wharf; the bottom of each well is in communication with the river bed, below low water, through two 42-in. diameter cast-iron pipes, which extend some 273 ft. into the river, and are provided with suction boxes and straining grids at their furthest extremities. Submerged in the bottom of each well is a Gwynne centrifugal circulating pump, with a capacity of 5,000 gal. per minute, having at least 7 ft. head at low tide, and a smaller charging pump of similar make, both being of the vertical spindle type, driven by 50 and 16 B.H.P. induction motors respectively, direct coupled at ground level. Two 24-in. diameter pipes lead from the wells into the boiler house basement, being there coupled by 15-in. branches to the condensers.

One 24-in. pipe is coupled through sluice valves to the bottom of each well and to the 42-in. river pipes, and the other direct to each circulating pump.

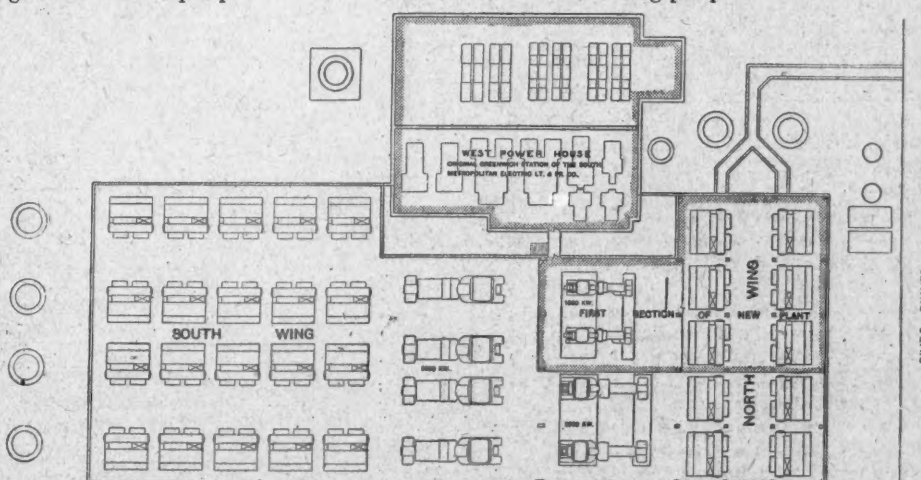


FIG. 16.—BLOCK PLAN OF PROPOSED POWER PLANT OF THE SOUTH METROPOLITAN ELECTRIC LIGHT AND POWER CO., AT GREENWICH.

This arrangement allows of either of the river pipes and wells being utilised for suction or delivery, the reversed flow being effective in scouring them of any sediment; it further enables full advantage to be taken of syphonic action in the pipes coupling the wells and condensers, which, of course, reduces the work done by the circulating pumps.

The circulating arrangement is shown in the plan of the station, fig. 2.

A spacious switchboard gallery is provided at one side of the engine house, the floor being of glass tiles.

The switchgear is comparatively unimportant, being only required for the control of the two generators and the electrical connection to the older station near by, from which, of course, the original mains network is controlled.

Three operating panels only are installed, as shown in fig. 12; these are of B.T.-H. standard type and include the two generator panels fitted with phase ammeters, voltmeters, watt-hour-meters, 2-phase 3,000-volt main oil switches with overload relays and field control switches; also an interconnecting panel with an oil break switch for coupling the turbines in parallel with the reciprocating plant in the West station, and with synchronising gear for the turbo-alternators.

Following usual practice the oil switches and bus-bars are mounted in stone compartments behind the operating panels and safeguarded by locked iron doors, &c.

An auxiliary distribution board for controlling the station lighting and motors is mounted beneath the switch gallery.

The engine room is plainly, though substantially, finished, the permanent walls and floor, where not iron chequer-plated, are finished with granolithic cement facing.

The present installation of course forms only a corner block of the proposed complete plant, two sides of the building being finished temporarily with corrugated sheet iron.

In conclusion, we are much indebted of Mr. H. W. Bowden, the managing director and chief engineer to the company, for facilitating our visit to the new plant, and furnishing much interesting material in this article.

NEW COMPANIES REGISTERED.

Guernsey Electric Light and Power Co., Ltd. (——).—This company was registered in Guernsey on July 20th, with a capital of £100,000 in £1 shares (50,000 preference), to acquire the business and property of Edmundson's Electricity Corporation, Ltd., in Guernsey, and to carry on the supply of electric light and power in that island. The first subscribers are:—F. Payton, 71, Page Street, Westminster, clerk, 1 share; C. H. Jones, 25, Queen Anne Avenue, Bromley, Kent, accountant, 1 share; J. G. Wigham, Coanwood, Hook Hill, Sanderstead, Surrey, engineer, 1 share; H. J. Butcher, Mayfield, Crescent Road, New Barnet, electrician, 1 share; F. E. Gripper, 2, Whitehall Court, Westminster, engineer, 1 share; V. G. Carey, Le Vallon Cottage, Guernsey, advocate, 50 shares; and J. Bishop, Grangehurst, Guernsey, 50 shares. The first directors are not named.

Treforest Electrical Consumers Co., Ltd. (94,335).—This company was registered on July 25th, with a capital of £100,000 in £1 shares, to produce, sell, distribute and generally deal in electrical energy, to manufacture, purchase, sell, let on hire or otherwise deal in or with plant, machinery, fittings, cables, wires, tubes, meters and the like, to adopt an agreement with the South Wales Electrical Power Distribution Co. (incorporated by Act of Parliament), and Stanley Boulter, to promote or concur with the last-named company or the Cwmbran Electrical Consumers Co., Ltd., or any other company or person in promoting any Parliamentary Bill or Provisional Order which may seem desirable, &c. The first subscribers (each with one share) are:—H. Bramwell, Llantrisant, M.E.; Sir Wm. T. Lewis, Aberdare, C.E.; R. B. Thomas, Dennel Hill, Tidenham, near Chepstow, steel manufacturer; W. H. D. Newton, Penarth, colliery proprietor; W. N. Lewis, Lisbane, near Cardiff, colliery proprietor; W. G. Dalziel, Northlands, Newport, Mon., M.E.; and W. H. Matthias, Tynycymmer, Porth, colliery owner. No initial public issue; the number of directors is not to be less than seven or more than twelve; the first are: H. Bramwell (chairman), Sir W. T. Lewis, Bart., R. B. Thomas, W. H. D. Newton, W. N. Lewis, W. H. Matthias, G. T. Hutchinson and W. L. Madgen; qualification (except any director appointed by the debenture agent pursuant to the above-mentioned agreement) £100; remuneration (in addition to any salary as managing director), £100 each per annum and £100 extra for the chairman.

Electrical Manufacturing Co., Ltd. (94,300).—This company was registered on July 23rd, with a capital of £13,000 in £1 shares, to acquire the business and undertaking of P. Walters & Co., of 249 and 251, Kensal Road, London, to adopt an agreement with W. Powles, and to carry on the business of electricians, electrical and telegraph engineers, railway contractors and suppliers, ironmongers, makers of electric tramcars, motor-cars and cycles, manufacturers of and dealers in dynamos, motors, telephones, bells, electroliers, arc and other lamps, electric light fittings, heating and cooking apparatus, &c. The first subscribers (each with one share) are:—W. Powles, 20, St. Quintin Avenue, North Kensington, W., electrical engineer; W. A. Hilton, 8, Kempson Road, Fulham, S.W., accountant; E. E. Moore, 112, Fielding Road, Bedford Park, W., electrical engineer; T. W. Cooper, 43, Rainham Road, Willesden, N.W., clerk; G. A. Walker, 25, Clifford Gardens, Willesden, N.W., instrument maker; S. S. Prust, 6, Okehampton Road, Willesden, N.W., cabinet maker; and A. C. Beadon, 14, Testerton Road, Notting Hill, W., battery maker. No initial public issue. The number of directors is not to be less than three or more than five; the first are W. Powles (permanent managing director; special qualification, 5,000 of the shares allotted to him under said agreement), W. A. Hilton, and E. E. Moore; qualification of ordinary directors, 250 shares; remuneration of managing director, in addition to his remuneration as an ordinary director, £500 per annum and an extra £100 when 15 per cent. dividend is declared; remuneration of directors (in addition to any salary as managing director or otherwise), £20 per annum. Registered office, 249 and 251, Kensal Road, London.

H. R. Jones, Wilson & Co., Ltd. (94,289).—This company was registered on July 23rd, with a capital of £1,500 in £1 shares, to take over the business of engineers, mill furnishers and electrical suppliers, carried on by H. R. Jones and S. R. Wilson, at 28, Chapel Street, Liverpool, as "H. R. Jones, Wilson & Co.," and to adopt an agreement with the said vendors. The subscribers (each with one share) are:—H. R. Jones, 3, Comely Bank Road, Egremont, Cheshire, electrical engineer; S. R. Wilson, 54, Balliol Road, Bootle, electrical engineer; E. G. Weale, 25, Lyttleton Road, Liverpool, managing clerk; J. Colwill, 58, Milroy Street, Liverpool, book-keeper; G. B. Wilson, 198, Stanley Road, Bootle, dentist; J. W. Usting, 17, Allerton Road, Birkenhead, freight clerk; G. P. Boucher, 27, Croxted Road, Liverpool, consulting engineer. No initial public issue; the number of directors is not to be less than two or more than three; the first are H. R. Jones and S. R. Wilson; qualification, £50 in shares or stocks. Registered office, 28, Chapel Street, Liverpool.

British Electrical Federation, Ltd. (94,252).—This company was registered on July 19th, with 100 members, each individual member being liable for 5s., and each company which is a member being liable for 5s. for every £1,000 of its authorised share capital, to encourage, promote, and protect the interests of the electrical and general engineering, carrying, contracting, wharfingering, tramway, railway, electrical, magnetic, galvanic, mechanical and chemical engineering industries, &c. The first subscribers are:—C. Rivers Wilson, G.C.M.G., 21, Pont Street, W.; E. Garcke, Donington House, Norfolk Street, W.C., managing director; E. Hopwood, 35A, Hertford Street, London, secretary; C. J. Tegetmeir, Sussex Gardens, West Dulwich, S.E., director; W. G. Bond, 167, Clarence Gate Gardens, N.W., director; J. Renwick, 29, Hillside Road, Stamford Hill, N., clerk; and C. H. Dade, Donington House, Norfolk Street, Strand, W.C., secretary. The management is vested in a council. The chairman for the time being of the British Electric Traction Co., Ltd., shall be president of this company and also president of the council and chairman of all committees.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Indo-European Telegraph Co., Ltd. (3,953).—This company's annual return was filed on May 22nd, when 17,000 shares had been taken up out of a nominal capital of £450,000 in 18,000 shares of £25 each. £425,000 has been received. Mortgages and charges: Nil.

West Coast of America Telegraph Co., Ltd. (52,114).—This company's annual return was filed on June 4th, when 45,008 shares had been taken up out of a nominal capital of £132,520 in 53,008 shares of £2 10s. each. £2 10s. per share has been called up on eight shares, resulting in the receipt of £20. £112,500 is considered as paid on 45,000 shares. Mortgages and charges: £170,000.

Harrington Electric Light Co. (Long Eaton), Ltd. (44,135).—This company's annual return was filed on May 27th, when 3,900 shares had been taken up and paid for in full out of a nominal capital of £5,000 in £1 shares. Mortgages and charges: Nil.

Anglo-Argentine Tramways Co., Ltd. (25,363).—A deed dated July 2nd, 1907 (supplemental to an indenture dated August 13th, 1888, securing £266,000 6 per cent. debenture stock) has been registered. Property charged: A concession dated January 3rd, 1900, relating to electric tramways granted by the municipality of Buenos Ayres; the company's Central Station in the said city, and all tramway stations, property and rights vested in the trustees of the deed of August 13th, 1888. Trustees: J. R. Corbett, More Place, Betchworth, Surrey; J. Heaton, Park Cottage, Datchet, near Windsor; and H. F. Gunning, 62, Gresham House, E.C.

W. R. Sykes Inter-locking Signal Co., Ltd. (Clapham) (93,078).—A trust deed dated July 9th, 1907, to secure £15,000 debenture stock, has been registered. Property charged: Certain leasehold land with the premises thereon in Clapham, adjoining the Clapham Road Station, and the company's other assets, present and future, except uncalled capital. Trustees: J. E. Nichols, Sussex House, Ravensbourne Park, Catford, S.E., and A. H. Johnson, Wanganni, Ashdown Road, Epsom.

St. Austell and District Electric Lighting and Power Co., Ltd. (66,382).—Issue on June 24th of £150 5 per cent. debentures, part of series created June 1st, 1904, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £1,650.

Joseph Overend & Sons, Ltd. (dynamo manufacturers, Bradford), (85,738).—£800 5 per cent. debentures, created June 24th and dated July 12th, 1907, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

Newquay Electric Light and Power Co., Ltd. (85,451).—Issue on July 13th of £300 5 per cent. debentures, part of series created July 30th, 1906, to secure £4,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £3,700.

Dolaca Syndicate, Ltd. (London), (19,098).—A memorandum of satisfaction in full of a charge dated March 18th, 1907, securing £11,250, has been filed.

CITY NOTES.

Electric Supply Corporation, Ltd.

The fifth annual meeting of the above company was held on Wednesday at Salisbury House, E.C., under the chairmanship of Mr. C. F. Tufnell.

In moving the adoption of the report (see Electrical Review, July 26th, page 147), the Chairman said he hoped they would agree that the report and accounts showed that the company had made good progress during the year under review, and he was pleased to say that the progress had been well maintained thus far in 1907. One specially satisfactory feature in the past year's accounts was that, in the case of the six towns which showed a loss in 1905—he referred to Dalkeith, Dollar, Jedburgh, Melrose, St. Andrews and Exmouth—every one of them, with the exception of Exmouth, had now turned the corner, and the revenue from sale of energy, meter rents, &c., exceeded the working costs. The same remark applied to Totnes, which was now working at a profit. As regarded Exmouth, the revenue had increased from £241 to £671, and it was confidently anticipated that during 1907 this town likewise would show a profit. As regarded the three new stations opened during the year—Hitchin, Dumbarton and Falmouth—they had, of course, no comparative figures to deal with. In Hitchin a good start had been made, and up to December last the equivalent of no less than 2,463 lamps were connected. Falmouth had but a bare month to run, so he need make no comment on that. In the matter of Chelmsford, they were unfortunate in losing during the year one of their best power customers through removal from the town, whilst on tendering afresh for the public lighting contract they had to make certain concessions to retain the business, which

for the time had thrown them back. Another satisfactory feature in their accounts was that in each of their four towns—Dalkeith, Dollar, Jedburgh and Melrose, which had their first year's working in 1905—the running costs showed a reduction notwithstanding the increase in revenue. The lamps connected on their whole system increased from 37,678 to 55,652. In Chelmsford the increase was 1,174, whilst in the seven other towns in which a comparison was possible the increase amounted to 9,947, and the three new towns had already 6,853 lamps installed. He would like to mention the progress made during the current year up to the last day of June, 1907. The number of lamps at Chelmsford had increased from 22,510 to 23,129; at Jedburgh from 2,969 to 3,097; at Melrose from 2,545 to 2,660; at Dalkeith from 3,776 to 4,203; at Dollar from 1,689 to 1,710; at Totnes from 2,555 to 2,770; at Exmouth from 4,742 to 6,019; at St. Andrews from 7,993 to 10,017; at Hitchin from 2,463 to 3,066; at Dumbarton from 3,478 to 4,135; and at Falmouth from 912 to 2,153. The first half of the year was usually the lean half for new applications, and so they would allow that these figures were promising. As regarded Dumbarton, since the completion of the financial year under review the Dumbarton Burgh tramways had been opened for traffic. The traffic returns had come fully up to the expectations, but the results did not, of course, appear in the accounts. The provisional order for the tramway mentioned at the last meeting, from Clyde Bank to Dumbarton, and from Dumbarton to Balloch, had been granted and confirmed by Parliament. The estimated outlay on the tramway amounted to £160,000, and it had been decided in view of the difficulty of raising capital, that it would be advisable for the Dumbarton Burgh and County Tramways to be carried on by a separate company. The Dumbarton Burgh and County Tramways Co. had accordingly been registered, and arrangements were being made for the necessary capital. By the agreement between the two companies, the Tramways Co. had contracted to take current from this Corporation's generating station for the whole term of the concession, paying, therefore, a price which would leave them a satisfactory profit. This would mean a good load on the Dumbarton generating station. The new company had further contracted to purchase from this company the Dumbarton Burgh Tramways, repaying them the costs already incurred in construction, approximately £45,000, which money would be available for the general requirements of the company, and particularly for development in other towns. The prospects at Dumbarton seemed excellent, and already one good agreement had been signed for the supply of electrical energy for running a large shipbuilder's yard. The company had promoted a Bill for the purpose of transferring and vesting in this company the several statutory powers under which the undertakings of the company were worked, and advantage had been taken of the opportunity to obtain Parliament's approval and sanction to the agreements with the several local authorities as to the legality of which some doubts existed. The Bill had received the Royal Assent. By the Bill the Chelmsford and Totnes Companies would cease to exist as separate companies, and their businesses would be transferred and form part of the general business of this company. There was no doubt that but for the difficulties of raising capital, owing to the state of the money market, the results would have been even more satisfactory than shown in the report. It had been decided with regard to Hendon to register a company, and this had been done, and their statutory powers transferred to the new Hendon District Supply Co. The Hendon Co. would take current in bulk from the North Metropolitan Electric Power Co. The necessary capital for the transforming station and the first instalment of mains had been found and the work was about to be put in hand. The company had received from the guarantors during the year £3,967 11s. 1d., which provided for the interim dividend paid last July, and extinguished the small debt balance for 1905 of £294 7s. 1d. The accounts showed a small profit of £151 9s. 2d. after payment of the debenture interest. Since December 31st the guarantors had provided a final dividend for 1906, and had provided the sum necessary to pay an interim dividend for the current year. It would be remembered that the amounts advanced by the Auxiliary Electrical Co. had to be repaid later out of surplus profits after the shareholders had received dividends at the rate of 6 per cent. per annum.

Major C. HEATON-ELLIS, J.P., seconded the motion, and the report was adopted without discussion.

Buenos Ayres Grand National Tramways Co., Ltd.

MR. J. IRVING COURTENAY presided on 24th ult. at the annual meeting held at Winchester House. He said that, owing to transition from horse to electric working, detailed comparisons between the two years were of little or no value. There had been expended during the year to March 31st, 1907, in London and Buenos Ayres on electric construction and equipment £266,368. Over the corresponding figures for 1905-6 the gross receipts from working for 1906-7 showed an increase of £68,660, or 27 18 per cent., the working expenses £27,496, or 14·25 per cent., and the net receipts £41,163, or 68 95 per cent. The percentage of working horse and electric together for 1906-7 was 68·60, as against in 1905-6 76·36, or a reduction of 7·76 per cent. The percentage of working the electric traction only for 1906-7 was 62·75 per cent. The number of passengers carried was in 1906-7 35,874,902, and in 1905-6 27,810,737, or an increase of 28 99 per cent. Passenger car-miles run were in 1906-7 7,014,999, and in 1905-6 6,676,738, or an increase of 5·07. The passenger gross receipts per car-mile were in 1906-7 51.75 cents; in 1905-6 42.36 cents, or an increase of 22·17 per cent., while the expenses per car-mile in 1906-7 were 35·63 cents, as against in 1905-6 33.03 cents, or an increase of only 7·87. The net receipts for the year under review exceeded those for the previous year by £41,163, or 68·95 per cent. All the horse passenger service of the company had been discontinued, and thus a source of unproductive expenditure had been eliminated. The number of miles of single track now converted to electric traction was 75¾ miles. Labour troubles had occurred in Buenos Ayres as elsewhere in the world, but these were occasioned by the operations of professional agitators, and the majority of their men remained entirely loyal. The report was adopted, and a final dividend at the rate of 3s. per share was declared on the 5 per cent. cumulative preference shares for the year.

Edmundson's Electricity Corporation, Ltd.

THE tenth ordinary general meeting of the shareholders of this company was held on Friday last, at Salisbury House, London Wall, Mr. Francis E. Gripper, M.I.E.E., in the chair.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, July 26th, page 146), explained how it was that he was in that position. He said that as the shareholders were aware, the meeting last year was presided over by Mr. Henry Wolfenden, who had previously been appointed chairman and joint managing director, which positions he held until February last, when he felt compelled to resign them. During the period covered by the accounts now before them, he (Mr. Gripper) had not been responsible for the policy of the company, and must not be held to be primarily responsible for the present position, although, of course, he shared that responsibility with the other directors. The report would have shown them that the results of the last year's working had been most disappointing, and he need hardly say had caused the board much anxiety. The revenue of the company was derived from two sources, namely, profit from trading, and income derived from investments. The net trading profit for the year, after deducting all expenses and charges, was only £4,056, as against £27,709 last year. It had always been foreseen that when the works of their various subsidiary companies were fairly established, the amount of contracting work done by the company must be greatly reduced, and the income from this source reduced in proportion. They would see, from one of the schedules enclosed with the accounts, that the capital of the whole of the undertakings in which they were interested only increased to the extent of about £92,000 during 1906. In 1905 the increase was £336,000, and in 1904 £526,000. The actual effect this year of this decrease in the amount spent by the subsidiary companies had been to reduce the amount of their sales by £191,000. The work of construction practically came to an end more than a year ago. There would be a very considerable amount of work still to be done in connection with extensions and additions to the various works, and they might improve upon this year's results, but they could not expect to derive anything like the revenue in the future that they had had from this source in the past. The policy of the board during the past year, especially in view of the difficulty there had been in raising capital for electrical undertakings, had been to restrict as much as possible all capital expenditure which could possibly be avoided or delayed, and this policy had necessarily had the effect of reducing their trading profit, and also, to a certain extent, had affected the development of some of their undertakings. This reduction in trading profits would have been of less serious concern if there had been anything like a substantial increase in the income derived from their investments. Unfortunately, there had been no such increase this year, the results actually showing a small decrease, namely, £31,136, as against £32,182 in 1905. In accordance with a suggestion made at the last general meeting, there was included with the report a schedule showing the results of the working of each of the undertakings in which they were interested. That showed that the profits in many cases had increased substantially, but the increased income had this year, to a large extent, been required for meeting charges on capital which, in 1905, did not rank for dividend, and the increased earnings had not benefited their company. For instance, the Urban company, which showed an increased profit of £5,131, had to pay considerably more than this amount in dividends on capital which, in 1905, did not rank for full dividend. Special circumstances which were not likely to recur accounted for the decreased earnings at Ilfracombe and the North of Scotland towns, and a general improvement in the returns might be looked for in the current year. The result of the year's working, after paying debenture interest, was a profit of £16,595 3s. 10d., which, with the sum of £15,211 12s. 2d. brought forward, gave a total of £31,806 16s. Dividends on the preference shares had been paid for the seven months ending October 30th, 1906, amounting to £14,000, and the balance remaining was £17,806 16s., which the directors recommended should be carried forward to the next account. A further dividend on the preference shares was due to have been paid on May 1st last. The directors very anxiously considered the question of paying this dividend, which, for the remaining five months of the year, would have required the sum of £10,000. At that time the accounts for the year were not, of course, available; but the directors felt that in paying this dividend, they would probably have to draw more or less heavily on the carry-forward from last year, and they decided, as they knew, to pass the dividend. They came to this decision after consulting a number of the large shareholders of the company whom they called together to advise with them on this matter. The general feeling was that in view of the difficulty in raising further capital, it would be unwise to draw in any way at the present time upon the reserve for the purpose of paying this dividend. Turning to the details of the accounts, they had made a reduction of £4,516 on the

working expenses. A saving had been made in salaries of nearly £2,000. No directors' fees had been paid, which had saved £600, and advertising, which cost them last year £490, did not appear at all this year. He thought this saving in advertising was a false economy, and that they would find it necessary to spend money on advertising again. The amount of debenture stock was shown as £460,000; but £25,000 of this amount was issued as security for temporary loans, and this amount had since been cancelled, leaving the amount issued at £435,000. Interest on debenture stock had increased by £3,426. Sundry creditors had been reduced to £29,256, as against £34,186 last year, and sundry debtors stood at £62,398, as against £66,475 last year. Their investments stood at £1,450,700, as against £1,413,100 last year, being an increase of £37,599 as compared with an increase of £132,509 the previous year. The amount of reserve against these investments had been increased by £3,330. With regard to their investments, the chairman said that the amount invested in the Lancashire Power Construction Co. had increased by £6,790. This was the only company from which they were actually getting no return, although he believed eventually it was going to prove a sound investment. The development of power companies had proved a very slow and disappointing business; but they had in Lancashire one of the best possible fields for such a company, and very considerable progress had been made during the year. The opposition of a large number of the local authorities had been overcome, and the power company had now a fair field for its operations. Its works were now in operation, and the output during the past half-year had been at the rate of over 5,000,000 units per annum. There was a note on the liabilities side of the balance-sheet, calling attention to contingent liabilities which existed. These liabilities were in respect to the guarantee of dividends given to the Urban company and to the annual payments which they had to make to certain local authorities whose undertakings they were working, all of which had, of course, been duly met. With regard to the Urban guarantee, the total amount which they had to find this year was £10,060. That figure included the amount which they themselves received as dividend on their holding in the Urban company. The total amount which they received as dividend from the Urban company in respect of their share holding was £11,248. In order not unduly to inflate the amount shown as dividend and interest from investments, they deducted the proportion of this dividend which they found themselves—viz., £5,658—and the balance of the guarantee, £4,402, had been charged against trading account, as in previous years. The deficiency in respect to their payments to local authorities this year was £4,013. This had been met by provision set aside out of profits made in carrying out the works for these local authorities. As a matter of fact, no actual loss had, up to the present time, been made in connection with these guarantees, and he did not think there was really any serious liability likely to accrue in the future; but in view of the criticism at their last meeting, the note had been placed on the balance-sheet. In consideration of the serious situation arising from the passing of the preference dividend, the directors asked the large shareholders, whom they called together, to appoint a committee to act in advising and assisting the directors in taking steps to improve the position of the company. The following gentlemen had constituted this committee:—Mr. H. Ansell, Mr. H. R. Beeton, Mr. F. E. Cooper, Mr. K. W. Hedges, Mr. George Kitchin, Mr. A. A. Campbell-Swinton and Mr. P. D. Tuckett. He proposed at a later stage of the proceedings to move a resolution formally appointing this committee, with a view to its continuing its investigations into the affairs of the company and reporting to the shareholders in the autumn. At the suggestion of the committee, Mr. P. D. Tuckett was elected to fill the vacancy on the board caused by the retirement of Mr. Wolfenden, and also, at their recommendation, Mr. A. A. Campbell-Swinton had been nominated by the board to fill the vacancy caused by the retirement of Mr. W. R. Davies. Mr. Tuckett and Mr. Swinton were both very large shareholders in the company, and they both had had large experience in electrical matters, and would greatly add to the strength of the board. The slow increase in the revenues of most of the undertakings was the real difficulty that the directors had to contend with. The business of electricity supply for several years past had been carried on under increasingly severe competition. The gas companies had had a weapon put into their hands in the improved incandescent gas mantle, which had enabled them to make a far better fight than three or four years ago anyone could have imagined possible. The effect of this competition had been felt by every electric lighting undertaking in the country, and especially in country towns, where the expense of electric lighting was much more carefully considered than it was in London and some of the larger cities. Even with this competition, electric lighting had not only held its own, but was making progress. He had every confidence that in the near future the new metallic filament lamp was going to do for them what the gas mantle had done for the gas companies, by enabling them to give their consumers two or three times as much light as they get at present for the same cost. They found few people who did not prefer electric light to every other form of light, and directly it could be used more economically they might expect a large increase in the consumption. Their stations were equipped with first-class modern plant, and they had practically no antiquated or obsolete plant which was likely to require to be replaced, as was the case with many older companies. In nearly all cases they were in a position to supply a much larger demand with only a small additional expenditure of capital; and he believed that they were going to get this much larger demand in the near future. In most of their towns they were gradually getting a very considerable number of power users to take their supply, and in quite a number of towns the amount of electricity supplied for power was very considerably in excess of the quantity used for lighting. In conclusion, he wished to express his belief in the ultimate success of the great majority of their undertakings. Many of them were going to take much longer in giving an adequate return than they anticipated when they went into them, and some of them, if they knew as much a few years ago of the difficulties in front of them as they knew now, they might have left alone. The only possible thing to be done was to devote all their energy to pushing on their development, and time and the admitted advantages of electricity would do the rest if a vigorous policy was pursued.

Mr. P. D. Tuckett, in seconding the resolution, said it was only a few weeks since he had joined the board, but it was obvious that the immediate cause of their trouble was the falling-off in their trading profits without any corresponding increase from the profit on investments. He was convinced that it would have been wiser for the board to have proceeded with greater caution in regard to their capital expenditure, and to have spread it over a very much longer period. It was the continued want of expansion in the profits derivable from their investments which constituted the really serious aspect of the situation. At the present moment they were about £28,000 short of the amount required to provide 5 per cent. dividend on the ordinary shares. Three years ago the profits from their investments rose from £18,000 to £30,000, and had they continued to expand in the same proportion they would have found themselves in a very different position to that which they now had to face. That the profits should have remained practically stationary was extremely disappointing, not to say disastrous. No doubt increased competition was largely responsible for this result; but apart from that, he could not help coming to the conclusion that the expenditure on capital had been unduly lavish, and, to a considerable extent, had been made without sufficient regard to the commercial considerations which should have governed it. The tendency had been too much in the direction of extending the business at all costs, irrespective of the return. He did not wish them to lose sight of the fact that, as a whole, their stations were well built, were splendidly equipped, and in most cases were being run economically. There was no question as to the soundness of the business from an engineering standpoint, or from a commercial standpoint—the difficulty was to get it to pay under the particular circumstances into which it had been allowed to get, and they would use their utmost efforts to that end. They hoped to effect economies, and in some cases it might be possible to revise rates slightly. It would probably be found desirable to secure more effective control of the conduct of the business at the various stations, and also to strengthen the board of management—those were some of the questions which the proposed Committee would have to consider. He believed that if it were possible for them to stand still, and simply await the normal development of the business without having to incur further capital expenditure, it would only be a question of a few years before the position would right itself. Unfortunately, however, development was only possible by the expenditure of further capital, and although they would make it their business to see that such capital brought in a return, it was certain that extra capital must be provided, and that, of course, must postpone the time when any profits could reach the ordinary shareholders. In his opinion, one of the first questions the Committee would have to consider would be the reorganisation of the capital account in order to finance the company over the critical position of the next few years. As to the passing of the preference dividend, if they had paid it, it would simply have been done in order to keep up appearances and would have been of no real benefit to the company. When a company met with difficulties, the best thing was to face them at once, and there was no getting away from the fact that this year the dividend had not been earned. There was a further consideration—the provision made for depreciation was wholly inadequate in the majority of the towns. Looking to the future, he was by no means pessimistic as to the ultimate success of the company. The Committee, although informally constituted, had already made some valuable preliminary investigations. It was a perfectly independent committee, and every member of the board had offered to place his resignation in their hands should they think fit to recommend such a course, and he had no hesitation in saying that there was not a single member who would hesitate for a moment to recommend a clean sweep of the board if they thought it was in the interests of the company. There was no desire on the part of the board to burke inquiry—on the contrary, he was glad to be able to say that they had done everything they could to assist the Committee in their investigations.

Replying to Mr. Barber, the Chairman gave the following particulars as to the holdings of the various members of the committee: Mr. Tuckett, 2,400 ordinary and 1,400 preference; Mr. Campbell-Swinton, 730 ordinary; Mr. Cooper, 200 ordinary, in addition to representing a large family holding; Mr. Hedges, 1,000 ordinary and 260 preference; Mr. Kitchin, 258 ordinary; and Mr. Beeton, 50 ordinary.

Mr. Pfungst remarked that both the chairman and Mr. Tuckett seemed to have overlooked the fact that the reason they had received such large sums in the past from their investments was because they had never put a sufficient sum aside for depreciation. If they went on neglecting that item, it meant that all their subsidiary companies must go into bankruptcy.

The Chairman said it was generally admitted that, in electrical undertakings during the first four or five years, while the business was being built up, it was impossible to provide a sufficient amount for depreciation. That had been the policy they had adopted, as far as they had been able to control their subsidiary companies, on the understanding that, after the expiration of four or five years, increasing amounts should be set aside for depreciation from year to year.

Mr. Robb asked whether the board admitted the allegation that the boards of the subsidiary companies were composed either of directors of Edmundson's or their nominees.

The Chairman: Certainly not.

Mr. Boot, who said he had been approached by many shareholders to look into the affairs of the company, in the course of a lengthy speech criticised the conduct of the directors in very strong terms. He said that the position in which the board had got the company was exceedingly serious from an electrical engineering professional point of view, as it prevented capitalists putting money into other electrical undertakings. They said: "Look at Edmundson's—see what they have done!" and he (Mr. Boot) admitted that their results were deplorable. Fortunately, however, for the electrical industry those results need never have been brought about. They had been brought about by a want of business ability. It was no use having engineering ability unless with it was combined business ability. The remarks of the chairman at the last annual meeting were very peculiar in the light of the present position, and they showed at once that the directors did not realise that they were fast driving to bankruptcy. It was the enormous capital outlay that had brought the company to its present disastrous position. Edmundson's was practically at the top of the list as far as their capital outlay per kilowatt was concerned. At Leamington the cost per kilowatt had run to the enormous sum of £289, or nearly five times what had been spent in other towns. At Inverness the figure was £150 per kilowatt; at Ventnor, £164; Sandown, £139; Newport, £280; and Ryde—all in the Isle of Wight—£291 per kilowatt, and yet the directors expected the company to pay after throwing money away like that! The total capital outlay for each lamp connected had amounted to no less than £2 5s. So long as they allowed the present board to go on spending money, the position would get worse and worse. He had seen most of Edmundson's stations, and they ought to have been municipal undertakings, judging from the magnificent buildings and the large amount of money that had been sunk in that way. He believed that electricity could be made to pay in the small towns, given a proper capital outlay, and proper business working. He would like to quote a criticism which appeared in the leading technical journal—the Electrical Review—on July 12th. Speaking of the company, that journal said:—"Proprietors in the Edmundson's Corporation seem content to allow their affairs to drift without obtaining that statement from the directors as to the actual position of the company which ought to have been made after the passing of the preference dividend. It is said that the board has been strengthened, but some degree of astonishment may be permitted at the supineness of the proprietors in not taking steps to obtain fuller information with regard to their company's concerns." That was what one of the leading technical journals had to say, and he hoped the shareholders would take note of it.

Mr. Barber proposed an amendment to the adoption of the report to the effect that the report be not adopted, but that the meeting be adjourned pending a report from the Provisional Committee.

Mr. Robb seconded. He said that the report gave the minimum of information. To say that the deplorable results put before the shareholders were due to the slow development in the demand was simply begging the whole question. The directors must be aware that they were due to many other considerations, and it was only right that they should have those matters before them before they adopted the report. He did not take a pessimistic view of the situation. He thought the market had written down the assets below their true value, and what they wanted the new directors to do was to preserve those assets by careful management rather than lose them by the expenditure of any unnecessary further capital. Of course, it might be absolutely essential and vital to the company to spend some more capital, but certainly any further capital expenditure ought to be kept down to the lowest possible limits.

After some remarks from Mr. Hedges and Mr. Campbell Swinton, the Chairman said it was a small point whether the report was accepted at that meeting or not. The Committee would have to report to an adjourned meeting as soon as they were ready, and, personally, he should have thought it wiser to have cleared up the business of the annual meeting that day. With regard to Mr. Boot's figures as to the cost per kw., that gentleman knew as well as he (the Chairman) did that in towns where they had only just started and where there was only a small amount of plant the outlay per kw. was necessarily very high. With every addition to the plant the expense came down very much indeed.

The amendment was lost by a large majority, and the report was adopted.

The appointment of Mr. Tuckett as a director was confirmed, and Mr. Campbell-Swinton was elected a member of the board in the place of Mr. W. R. Davies, resigned.

On the motion of the Chairman, the Committee of shareholders was reappointed "with power to employ legal and expert assistance for the purpose of inquiring into the position and prospects of the company and reporting to a general meeting of the shareholders to be hereafter called." It was agreed to give the committee power to add to their number if necessary.

Sun Electrical Co., Ltd.—In the Chancery Division of the High Court of Justice on Wednesday, Mr. Justice Neville in this case sanctioned a petition by this company for the reduction of the amount of its issued capital from £23,764 to £19,164. Henceforth the capital of the company is £45,400. At the time of the registration of the minute, the issued capital was £19,164.

Direct United States Cable Co., Ltd.

Mr. E. M. Underdown, K.C. (Chairman) presided at Winchester House, Old Broad Street, on Friday, over the sixtieth ordinary general meeting of the above company.

The Chairman, in proposing the adoption of the report (see Electrical Review, July 26th, page 144), said he was glad to say the company was in the position of the country which was considered to be so happy since it had no history. They had had no exciting episodes to deal with. Their traffic was going on well at the present time. They had suffered no misfortune, and he trusted all would consider that satisfactory. The revenue for the six months ending June 30th, after deducting out payments, amounted in round figures to £57,056. The working and other expenses, including provision for the pension fund and income-tax, but exclusive, of course, of maintenance of cables, was £24,699, leaving a balance of £32,357 as net profit, and this, with £17,032 brought forward, made a total of £49,389. This had been appropriated as follows: By the payment of an interim dividend of 4s. per share, £12,142; proposed final dividend at the rate of 4s. per share and bonus of 2s. 6d. per share, £19,731; transferred to reserve, £15,000; and carrying forward £2,576. The revenue had shown a slight improvement over the corresponding period of 1906, although that was a very active period in the Atlantic cable business. The working expenses in London and at the stations were naturally increased owing to greater activity, while the remaining expenses were more or less of a fixed character. The reserve account had been credited with £8,790 from interest and investments, and £2,367 from profit on sale of securities, with the £15,000 he had mentioned transferred from revenue. On the other hand, it had been debited with £4,184 for the cost of maintenance of cables, and with £40,000 which they had decided to put aside as a provision on account of depreciation of securities. The fund would then amount to £491,968. He firmly believed that the reduction shown in the securities was only of a temporary character, and that they would return to a more normal state of things. Meanwhile they could congratulate themselves that the period of reduction had had so small an effect upon the securities—no more than 7 per cent. A summary of the results for the financial year showed the receipts to be £117,435, and the expenses and ordinary payments £50,080, leaving £67,350. They had paid in dividends £35,156, and, apart from the depreciation in the market value of the securities, the reserve fund had been increased by £27,784. He was not present at the last meeting, owing to his being in the United States, but whilst there he had visited the New York office, and he assured them that the arrangements there and the work of the staff were most satisfactory.

Sir James Pender seconded the motion, and the report was adopted without discussion.

Anglo-American Telegraph Co., Ltd.

Mr. F. A. Bevan (chairman) presided at Winchester House, E.C., on Friday, over the half-yearly meeting of the proprietors of the above company.

In moving the adoption of the report (see Electrical Review, July 26th, page 145), the Chairman said they might congratulate themselves upon the progress of the business during the past half-year. The traffic receipts had increased by about £2,200, but there had been a falling-off in the earnings of the ss. *Minia* of just over £4,000. As he always reminded them, those earnings were a very precarious source of income, and never could be counted upon. Deducting the increased profit receipts from the diminution in the amount produced by the *Minia*, there was a net decrease of £1,312 16s. 5d. But on the other hand, the working expenses had decreased. The law expenses were less by £283, and the working expenses by £689. The chief decrease, however, was in the charter of a ship for repairs to cables. Last year they had to pay a considerable sum for the charter of a ship to repair a cable broken on this side. This time they had not had to do that, with the result that there was a net decrease of expenses of £5,461 4s. The result was a gain on revenue for the six months of £4,100, which roughly accounted for the increased balance carried forward. As to the forthcoming half-year, it was, of course, dangerous to prophesy, but he hardly thought they could expect the very large receipts they had in the corresponding half-year. Then there was great activity on the Stock Exchange, which might not take place again this half-year. As they were aware, the directors had thought it right when they communicated the dividend to the Stock Exchange to allude to the fact that there had been considerable depreciation in the value of securities held on account of the renewal fund. The depreciation amounted to no less than £83,000. As was known, they had entered into a sort of agreement with the deferred shareholders that their renewal sum should stand at £1,000,000, and in face of the depreciation he had mentioned, it, of course, now stood at a considerably less figure, and the question arose as to what they were to do. It so happened that they were engaged in renewing the shore ends of two of their cables, and this would absorb about £40,000, which would have to come out of the renewal fund. Towards that there was the nominal surplus on the renewal fund of £26,000, and there was £15,000, the half-year's interest on the securities, making £39,000 towards the £40,000. That brought down their renewal fund to the nominal value of £1,000,000, but to a real value of not quite £920,000. Under those circumstances the directors thought it was only right to resume the operation which they had carried on for some years of setting aside £20,000 out of their annual receipts towards making

up the renewal fund to the real value of £1,000,000. If they had good fortune, and did not have to draw on the fund for repairs, it would, of course, not be long before the sum was made up. They would not, of course, revalue every year, but would revalue in three years. What the case might be then he could not say, but at the present it did not look as if securities were likely to rise, and certainly not in the immediate future. Their allies the Direct United States Co. had announced that their depreciation was £43,000, and they proposed to write off about £40,000. When it came to the end of the year he presumed that they would write off the amount of depreciation and then place to the credit of the renewal fund the £20,000 out of the receipts of which he had spoken. They had purchased for their working office No. 63, Broad Street, as the lease of the offices they at present occupied would shortly expire. He congratulated the shareholders on getting an office in such an admirable position. He had spoken of the repairs of shore ends, and might say that they were subject to damage by trawlers. The company had communicated with the Government authorities on that point, and they had promised to take the matter into serious consideration. They had had a lawsuit with the Newfoundland Government, who proposed placing a tax of £800 on each of their cables. The decision in the local Courts had gone against them, and the board were considering whether they would appeal to the higher Court in England.

Sir Gerald Fitzgerald, K.C.M.G., seconded the motion.

A Shareholder asked how the company had got on with the French lawsuit.

The Chairman said it was as dead as the dodo. They had received about £1,100 in that matter.

Considerable discussion took place as to the manner in which the depreciation of securities should be dealt with, and several shareholders advocated the formation of a special reserve fund depreciation account, so that in the case of a rise in values the subject could be more easily dealt with.

The Chairman promised that the board would consider how best to deal with the matter.

The report was adopted.

General Electric Co., Ltd.

The annual meeting was held at the offices on Friday last. Mr. G. Byng presided, but as he was not feeling very well, his speech was read by the secretary, Mr. K. Alwood. In this he stated that the accounts did not differ very materially from those of last year, which, under the prevailing conditions, must be considered satisfactory. They had added to their properties to the extent of £19,200, which had gone entirely into extensions of works, buildings and machinery. This sum was not as large as it had been during the last few years, but it proved that even in quiet years a manufacturing concern constantly required additional capital outlays, and such additional capital could be provided only by fresh issue of capital or by profits. They had so far avoided any further issue of shares, except ordinary shares, which mostly represented the reinvestment by the directors of the dividends declared upon those shares from year to year. The sum written off for depreciation was about the same as last year, and was considered ample. Stocks again showed an increase, which was largely due to dearer raw materials. The stocks were valued on a most conservative basis. Such rises were largely due to the manipulations of foreign trusts and speculators. There seemed to be some idea in the mind of many that our trade system enabled them to obtain cheap raw materials. All facts experienced in the course of this company's business during the last few years had just proved the contrary. English manufacturers possessed no means whatever—they seemed even to have lost the means they had in the past—of influencing the prices of raw material. Events were showing that if there were no trusts in England they were dependent on foreign trusts, and that they had no weapon whatsoever with which to fight them. Much could be done to counteract this most disturbing element in industrial activity, which would be a very serious matter in the near future to our working population. The only effective step would be a combination under the guidance of the Government. The year had been marked by the introduction of an important invention affecting the electric lighting industry. The aim at which they had worked for a great many years, namely, that of improving the efficiency of the incandescent lamp, had been attained by the introduction of a lamp having the Wolfram (Tungsten) metallic filament as a basis. He was of opinion that the advent of this lamp would have a most beneficial effect upon the industry. They had come to a sound business arrangement with the holders of the first, and what they were convinced were the master patents of this lamp, and, in connection with their Robertson lamp factory, they had made arrangements for its manufacture in England. In the meanwhile they had secured for the immediate sale in this country a considerable proportion of the output of the German works. The works had been kept busy throughout the year. Mr. Railing at Witton, and Mr. Bevis at Peel Works, had travelled abroad to keep themselves constantly informed of any progress made, and thus both these important works had been kept up to date by adopting every improvement necessary for efficient and scientific production. The Carbon Works had done fairly well, and they had again to acknowledge the great help which the Home and Colonial Governments had given them in this undertaking, but he could not help complaining of the action of many municipalities in this country. For the sake of sometimes a few per cent., many an order for town lighting had gone abroad, and he was sure the municipalities ought to be made to see that the little immediate gain meant an ultimate loss to themselves and the country. Prices for heavy work had been kept low mainly through internal competition. They had found foreign competition less active during the last year, but there were indications that business on the Continent was getting slacker, and that dumping would soon begin here again. For instance, last year they carried out a large contract in the West of England to the entire satisfaction of their customer. An extension of this contract was advertised, and within three days seven Continental travellers were on the spot, and three offered to do the work at considerably lower prices than the lowest English tender, whatever that might be. They were often told that the reason why protective duties were not good for England was that they would divert the natural channels of trade. Our free import system was doing that more than any protective duties ever could. Surely nothing more unnatural in trading could be produced than that an order of this description, which in the natural course of events would certainly have come to English works, should be placed abroad. This uncertainty as to foreign competition was worse for the English manufacturer than the actual competition itself. They were entirely at the mercy of the foreign manufacturer, who left them alone or dumped upon them whenever it pleased him, and all experience and circumspection were useless. He did not call that a natural state of affairs. The company's profits were less than last year by about £2,000; to that extent they had been obliged to reduce the amount placed to the credit of reserve account. The reserve stood now at £118,000. The ordinary shares had been increased by £96,000 since the formation of this business into a public company. The security behind the preference shares had therefore increased by £214,000, or 85 per cent. Their preference shares should be called gilt-edged, and no doubt would be were they living in normal times. Many difficulties beset the path of manufacturers. He pointed to the remarkable apathy of finance in connection with electrical enterprises, as compared with the flow of capital into electrical undertakings experienced in Germany and America. The conservative financial policy of the General Electric Co. made them independent, to a large extent, of the financial situation; yet much legitimate expansion was prevented, and many profitable foreign undertakings went abroad, in consequence of this lack of reasonable financial assistance. England's industries used to be assisted formerly by abundant capital. Very little of such capital was available at present, but their foreign competitors enjoyed this advantage now to our detriment. This was a serious matter. He regretted to find that our authorities misinterpreted or misunderstood the financial situation affecting British industries. That money was tight, that public loans remained unsubscribed, that Consols fell, could not be denied by the most prejudiced official; but they were told that the reason was that trade was so good, it absorbed all capital. He could speak with some authority for the engineering and electric lighting industries, and he regretted to say that this official version was entirely incorrect. Capital had not been absorbed in these industries, simply because it could not be obtained. That this lack of capital must affect this company was natural. They relied largely upon municipal and public works, and the fact that money was dear had a detrimental effect on big undertakings; but it also had a great influence upon thousands of their customers, and the complaints that money was tight had been more frequent than ever. Another great evil was the abuse of our limited company laws. The tendency of every little man to turn himself into a limited company with £7 share capital and £5,000 debentures was becoming daily more accentuated. It made the giving of credit most precarious, it interfered with the legitimate trader, it led to positive dishonesty and swindling, and to his mind constituted a public scandal. Though their balance sheet was considered satisfactory, yet it would be idle to say that he was satisfied with the results of their efforts. When they compared themselves with their competitors in England they might even congratulate themselves, as unfortunately many of them had shown almost disastrous results, but when they looked abroad they found their competitors were almost without exception in a most flourishing state. This and many other indices pointed conclusively to the fact that the unsatisfactory state of the industry was due to conditions obtaining in England exclusively. What they were was quite clear to his mind. In one sentence, it was due to the support which foreign governments gave to their producing industries and which was denied to companies here. It was incomprehensible to him that English manufacturers did not combine to put their case clearly before the country and the government. He was sure thousands of manufacturers must see and feel as he did. He was sure our Government did not deliberately wish to injure our industries. It was true that they had allowed our agricultural industries to go down without lifting a finger; surely the country would not allow our manufactures to go the way our agriculture had gone! He felt the whole thing was a misunderstanding. It was like a nightmare.

Mr. Byng concluded his remarks thus: "On the one hand the dread of destruction, on the other hand, the promise of prosperity and nothing to stand in the way, nothing but the want of knowledge. Our Government is largely composed of men who cannot see eye to eye with the manufacturer. I wish they could. I wish they would allow the manufacturer some sense of honesty and some knowledge of his own affairs. I will give you an instance how the whole thing is owing to misunderstanding. We manufacturers hold it to be a truth based upon our daily experience and knowledge that the regulation of foreign importation by Customs duties would cheapen our cost of production. The official representatives of our Government, however, hold the contrary view, and their reply is that the imposition of Customs duties would increase the cost of production to the manufacturer. Surely such contradictory views should not exist in the minds of men who all desire the prosperity of our manufacturing industries, if an unbiassed investigation were held. Do not think that I am taking up at a shareholders' meeting matters

that do not concern shareholders. They concern them most vitally, and I hold it a great pity that the mouth of many a manufacturer is shut by the stupid assertion that if he talks upon what concerns him vitally, he is talking politics. I am sure concerns like our company are the mainstay of our social fabric. We employ thousands of citizens, we teach them, we pay them, upon our success alone 20,000 souls rely for their daily maintenance. We support the State by contributions in taxes and rates, we are anxious, I may honestly say, to improve the position of our working people and our staff. I think we have a right to demand to be heard, and to direct the attention of our shareholders, of the public, and those in authority to questions which are in urgent need of settlement, and which a manufacturer is bound to grasp better than laymen."

Mr. H. Hirst seconded the adoption of the report, which was carried. No discussion followed. The dividend resolution (5 per cent.) was also passed. Mr. H. Bevis was re-elected a director and the auditors were re-elected.

Metropolitan Railway Co.

Sir Chas. McLaren, M.P., who presided at the half-yearly meeting held last week, stated a number of reasons why the apparent decrease of £43,495 was an actual fall of £22,422. Among the causes was motor-omnibus competition, of which they still felt the effects, but they had every reason to believe that the omnibus companies would abandon the policy of cutting fares, and adopt more remunerative charges, which would ensure a fair return to all concerned. That was all they wanted—a fair return to everybody; and he thought the public would be quite prepared to pay. Another cause for the decline in the passenger receipts was to be found in their having ceased to work their trains over the East London line, which was not equipped for electric traction. After much negotiation they had had some meetings with the representatives of the District Railway, the Central London Railway, and the other tube lines a few months ago, with a view to getting the fares from Hammersmith and other stations in the West of London to the City put on a more remunerative basis. An agreement was unanimously come to on the subject, and the fares were raised to a moderate extent on July 1st, both on their line and on the Central London, and certain alterations were made in the fares on the tubes and District Railway. They would agree that to carry a passenger from Hammersmith to Aldgate and back, a total distance of nearly 18 miles, in the fine electric trains which they had provided, and over a line which cost hundreds of thousands of pounds per mile to make, for 4d., as they did up to the end of June, was an arrangement that could scarcely be expected to be permanent. The effect of increasing the fares had, so far, quite come up to their expectations, and they had every reason to suppose that the result would continue to be satisfactory. They had set aside, a short time ago, a considerable sum of money for the purpose of cleansing and renovating their stations generally on the introduction of electric traction. The dividend was unpleasantly small, but he did not think it was any less than they had expected, having regard to all the circumstances. The half-year upon which they had entered, however, held out brighter prospects, and he sincerely hoped that it was the last time he would have to come before the proprietors with so poor a result.

Chilian Electric Tramway and Light Co., Ltd.

The report for the year ended December 31st, 1906, shows that the renewal fund, £8,867, has been charged with the cost of the modifications and the restoration of the property damaged by the rioters in Santiago. Of this fund £2,274 remains unexpended. Owing to frequent traffic disturbances, caused by several serious breakdowns of the machinery at the power station, and also owing to the occurrence of an earthquake in Santiago on August 16th, 1906, which stopped the service during eleven days, the total passengers carried was less than during the year 1905 by 9,098,550. For the same cause the tramway receipts showed a decrease of $329,365·80 compared with the figures for the year 1905. The power station is now in thorough efficient order and condition and there have been added two new accumulator batteries, one turbine and two boilers, increasing the power capacity to 5,700 kw. The rolling stock has also been added to by ten new cars, and 20 are on order. After prolonged negotiations the company has obtained a prolongation of the concession for a further 25 years. The concession will now run to the year 1953. In December, 1906, a contract was entered into with the Deutsch-Ueberseeische Elektricitäts-Gesellschaft, of Berlin, for that company to supply this system in Santiago with energy produced from water-power at a rate much below the present cost of power. When this installation is complete the directors look for a substantial decrease in the operating expenses. The business of the electric lighting department suffered during the year owing to the disturbances and breakdowns in the power station and the earthquake. In spite, however, of these disadvantageous circumstances, this department showed the following increases as compared with the year 1905:—In private lighting, 32 per cent.; in public lighting, 1 per cent.; whilst the tramway service required 7 per cent. less energy, so that, including the amount required for the company's own consumption, the consumption in 1906 was 7,668,752 units, against 7,688,277 units in 1905. The number of customers increased from 849 in 1905 to 1,360 at the end of 1906. The cost per unit was greatly increased, however, owing to the difficulties with the power house machinery, and the increase in the cost of coal. Wages and salaries also were greatly increased owing to the earthquake. The board announce the death of Mr. Samuel Kocherthaler, director. In April, Mr. E. Rathenau resigned his seat on the board and Mr. J. H. Müller, of Berlin, was appointed in his place.

Blackpool and Fleetwood Tramroad Co.—The dividend for the half-year to June 30th is 4 per cent. (the same as last year); £750 is placed to depreciation and reserve, £500 to the general reserve, and £212 is carried forward.

Anglo-Argentine Tramways Co., Ltd.—This company held on July 26th an extraordinary general meeting, at which resolutions were unanimously passed for carrying into effect a provisional agreement entered into with the Compagnie Générale de Tramways de Buenos Ayres, dated July 13th, 1907, having reference to the acquisition of the Buenos Ayres and Belgrano Electric Tramways Co.'s undertaking. Mr. J. B. Concannon presided.

Topsham Electricity Supply Co., Ltd.—The annual general meeting of this company was held last week. The directors' report showed an unlooked-for progress, the number of consumers having more than doubled, and the consumption increased in even greater proportion during the year. New plant, a storage battery, and extension of mains, had been provided. The directors recommended a dividend of 3 per cent. on the ordinary shares, and the carrying of the remainder of the profit to the reserve fund. The secretary reported that the work of removing to the new premises would probably be completed by about the third week in August.

Rio de Janeiro Tramway, Light and Power Co., Ltd.—Those who take or desire to take an investing interest in this company's undertaking can obtain from the British Empire Trust Co., Ltd., of 34, Nicholas Lane, Lombard Street, E.C., a bulky and interesting account thereof, prepared by Dr. F. S. Pearson, of Toronto, by making written application. The report contains many fine half-tone views, maps, &c.

Bell's Asbestos Co., Ltd.—Interim dividend of 6d. per share (5 per cent. per annum) for the half-year ended June 30th.

City of Buenos Ayres Tramways Co. (1904), Ltd.—The directors have declared a dividend of 1s. 3d. per share for the three months ended June 30th (the same rate as last year).

Buenos Ayres Electric Tramways Co. (1901), Ltd.—At this company's meeting held on July 25th at 62, London Wall, Mr. E. A. Lazarus moved the adoption of the report, which showed that the net profits were £15,075, against £13,286 in the previous year.

Dublin United Tramways (1896), Ltd.—The report for the half-year ended June 30th shows that, after charging against the revenue the balance of cost of reconstruction of portion of the Dalkey Line, £3,157, and the cost of alteration in certain streets from centre to sidepole overhead construction, £41,175 remains for division. A dividend at the rate of 6 per cent. per annum on the ordinary shares is recommended, as in 1906, leaving £6,615 to be carried forward.

Prospectuses.—*Paris Metropolitan Railway Co.*—The *Financial Times* says that this company will shortly proceed with the issue of a second series of 50,000 bonds of 500 fr. each, in order to provide funds for the equipment of other sections of the line. The bonds are to be of the 4 per cent. class.

Sungei Salak Rubber Co., Ltd.—Subscriptions have been invited for 41,000 shares of £1 each. The company acquires, and will work and develop as rubber estates, the properties situated in Negri Sembilan, one of the Federated Malay States. In May, 1907, 1,080 acres were planted with 140,000 rubber trees.

Stock Exchange Notices.—The Committee has appointed a special settling day as under:—

Thursday, August 8th.—Electric Traction Co., of Hong Kong, Ltd.—325,000 shares of £1 each, fully paid, Nos. 1 to 325,000.

And ordered the undermentioned to be quoted in the Official List:—

Birmingham and Midland Tramways, Ltd.—Further issue of £152,237 4½ per cent. first debenture stock.

Vickers, Sons & Maxim, Ltd.—Further issue of 100,000 ordinary shares of £1 each, fully paid, Nos. 3,562,501 to 3,662,500.

Application has been made to the Committee to allow the following securities to be quoted in the Official List:—

National Telephone Co., Ltd.—Further issue of £616,425 deferred stock.

Oxford Electric Co., Ltd.—The directors have declared an interim dividend at the rate of 5 per cent. per annum on the ordinary and preference shares for the half-year ending June 30th. The same dividend was paid last year.

North Metropolitan Electric Power Co.—An extraordinary meeting of this company was held on Tuesday, Mr. C. G. Tegetmeier presiding. A resolution was passed authorising the board to borrow a sum not exceeding £133,000, by the issue of debentures carrying interest at 4 per cent. per annum.

National Gas Engine Co., Ltd.—Interim dividend at the rate of 5½ per cent. per annum on preference shares, and 20 per cent. per annum on ordinary shares, for the six months ending June 30th, 1907.

Westminster Electric Supply Corporation, Ltd.—Interim dividend for the half-year ended June 30th at the rate of 10 per cent. per annum. (Last year 11 per cent.)

British Electric Traction Co., Ltd.—Half-yearly dividend on the preference shares at the rate of 6 per cent. per annum.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	*	No. of wks.	Total to date. £	*	Route miles open.	Inc.
Aberdeen	July 24	3,784	+ 224	8	12,200	— 25	14·4	..
Ayr	,, 27	1,605	+ 51	10	4,246	— 159	5	..
Bath	,, 24	1,825	— 141	30	22,664	— 491	13	..
Belfast	,, 26	7,907	+ 895	17	62,818	+ 4,236	40	..
Birkenhead	,, 28	2,208	— 49	17	17,807	— 507	19·52	..
Birmingham Corp.	,, 27	10,620	..	17	101,612	..	56·45	..
Blackburn	,, 24	2,392	+ 219	17½	19,333	+ 764	14·18	..
Blackpool Corp.	,, 25	3,913	— 107	..	17,990	— 1,568	11·87	..
,, —Fleetw'd.	,, 27	2,499	— 118	3	4,175	— 331	8·25	..
Bolton	,, 28	4,970	+ 512	17	38,834	— 1,455	42	..
Bournemouth	,, 24	3,816	+ 328	16⅔	27,764	+ 173	21·5	2⅔
Bradford	,, 27	10,598	+ 755	17	79,763	+ 328	53	..
Brighton	,, 28	2,078	— 146	17	15,466	— 1,505	9·5	..
Bristol	,, 26	10,707	— 181	..	..	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	,, 19	454	+ 24	18	6,319	+ 16	3·65	..
Barnsley	,, 19	831	+ 12	,,	4,606	— 6	..	..
Barrow	,, 19	668	+ 30	,,	6,894	— 69	5·87	..
Cavehill	,, 19	365	— 20	,,	2,362	+ 107	..	..
Devonport	,, 19	1,044	— 29	,,	12,744	+ 6	8·85	..
Gateshead	,, 19	2,052	— 218	,,	28,175	+ 695	11·25	..
Gravesend	,, 19	562	+ 15	,,	6,647	+ 2	6·5	..
Greenock	,, 19	1,517	+ 193	,,	18,629	— 19	7·25	..
Hartlepool	,, 19	698	— 26	,,	7,776	— 438	6·72	..
Kidderminster	,, 19	306	— 47	,,	3,124	— 160	..	..
Leamington	,, 19	371	— 81	,,	4,280	— 680	3	..
Merthyr	,, 19	441	+ 40	,,	5,843	+ 515	2·9	..
‡Metropolitan	,, 19	10,849	+ 3,225	,,	124,290	+ 29,037	22	..
Middleton	,, 19	798	— 35	,,	9,731	— 200	8·5	.
Mid. Joint Com'tee	,, 19	12,160	..	,,	160,981	..	..	..
Oldham — Ashton	,, 19	1,248	..	,,	16,797	+ 786	9·13	..
Peterborough	,, 19	379	— 29	,,	3,401	— 124	5·81	..
Potteries	,, 19	3,665	+ 172	,,	52,663	+ 1,342	29	..
Rothesay	,, 19	1,677	+ 188	,,	5,681	— 254	2·75	..
Southport	,, 19	779	+ 42	,,	7,879	— 517	8·17	..
S. Metropolitan	,, 19	1,804	..	,,	21,221	..	..	..
Swansea	,, 19	1,980	+ 144	,,	23,869	+ 783	5·5	..
Tynemouth	,, 19	821	+ 61	,,	6,118	— 674	3·75	..
Weston-s-Mare	,, 17	580	— 66	,,	2,677	— 360	3	..
‡Worcester	,, 19	648	— 22	,,	7,566	— 217	5·75	..
Wrexham	,, 19	213	— 4	,,	2,806	— 37	..	..
Yorks. Wool. Dist.	,, 19	2,005	+ 183	,,	26,725	+ 1,307	17	..
Miscellaneous	,, 19	473	..	,,	6,070	..	..	..
Burnley	,, 27	2,590	+ 353	..	..	..	7·5	..
Burton-on-Trent	,, 28	718	+ 62	17	5,009	— 252	10	1·5
Bury	,, 21	1,301	..	16	17,623	..	10·5	..
Cardiff	,, 27	2,245	— 42	17	38,091	+ 2,270	15·87	..
Carlisle	,, 17	453	+ 19	30	5,062	— 359	..	..
Chatham and Dist.	,, 25	1,747	+ 220	30	20,807	+ 1,332	12·84	2·55
Cork	,, 25	1,151	— 14	30	13,606	— 450	9·89	..
Croydon	,, 26	3,078	— 32	17	24,452	— 1,537	12	·75
†Darlington	,, 20	281	+ 5	16	3,408	— 8	.	..
†Darwen	,, 26	517	+ 44	17	4,857	+ 15	4·36	..
†Dover	,, 27	517	— 119	17	3 940	— 555	4·75	..
Dublin	,, 26	15,288	+ 3,808	26	27,428	+ 6,730	54·25	5·5
Dundee	,, 24	2,233	+ 95	16	11,592	+ 894	13	·5
East Ham	,, 27	1,939	— 64	17	15,678	— 402	8	..
Exeter	,, 26	749	+ 115	17	5,466	+ 491	4·75	·5
Glasgow	,, 27	31,304	+ 3,790	8	140,909	+ 1,474	89·75	8·5
Hastings	,, 25	2,630	..	..	..	..	..	..
Huddersfield	,, 27	3,349	+ 226	17	27,077	+ 1,010	28	..
Hull	,, 27	4,741	+ 59	17	40,461	+ 1,947	18	..
Ilkeston	,, 24	305	+ 22	17	2,421	+ 163	3·5	..
Ipswich	,, 27	983	— 70	15	6,960	— 567	10·5	..
Isle of Thanet	,, 27	2,396	— 90	30	14,389	— 545	11	..
Kilmarnock	,, 27	449	— 3	10	1,815	— 5	4·25	..
Lan'kshire Trm. Co.	,, 25	3,073	+ 1,250	30	34,064	+ 8,145	15·82	3·26
Lancashire United	,, 24	2,952	+ 709	30	36,313	+ 9,580	38·5	9
Leeds	,, 27	13,793	+ 787	17	111,463	+ 4,257	96	6·5
Leicester	,, 27	4,742	— 26	..	..	..	..	..
†Leith	,, 20	1,355	+ 149	9⅓	5,365	+ 74	6	..
Liverpool	,, 20	33,238	+ 758	29	310,592	+ 4,148	104	..
‡L.C.C.	,, 26	55,015	+ 12,492	17	498,629	+ 76,579	116⅔	22·83
London United	,, 26	16,361	+ 1,681	26	185,612	+ 4,310	..	..
Lowestoft	,, 27	567	— 6	43	7,296	+ 915	3·5	..
Manchester	,, 27	32,551	+ 3,284	17	251,066	+ 20,189	172	20
Newcastle	,, 27	8,141	+ 117	17	71,160	+ 299	..	..
Newport	,, 27	1,423	+ 117	17	12,671	+ 1,539	14·5	..
Northampton	,, 26	948	— 40	16⅔	7,384	— 357	6·5	..
Oldham	,, 28	4,270	+ 440	18	34,907	+ 2,248	23·06	..
Pontypridd	,, 27	535	+ 213	17	4,525	+ 1,605	5	1·75
Portsmouth	,, 27	4,635	— 262	..	83,524	— 1,023	14·5	..
Preston	,, 24	1,629	+ 72	..	..	..	..	..
Reading	,, 26	1,304	— 71	16⅔	10,316	— 456	13·25	..
Rotherham	,, 25	1,188	+ 170	16⅔	9,850	+ 1,459	10	·66
Salford	,, 29	9,775	+ 884	17	80,797	+ 1,627	38·9	..
Sheffield	,, 28	11,511	+ 688	18	99,606	+ 4,320	35·75	..
Southampton	,, 24	2,229	+ 60	16	16,705	+ 376	..	..
Southend-on-Sea	,, 24	1,035	— 9	17	6,354	— 354	..	..
Sunderland	,, 28	3,177	+ 25	17	24,484	— 140	..	..
†Swindon	,, 17	154	+ 6	..	..	..	4·4	..
Tyneside	,, 24	1,616	+ 108	30	13,740	+ 663	8·87	..
Wallasey	,, 27	1,970	+ 112	17	14,426	+ 279	3·72	·05
Walthamstow	,, 27	1,463	+ 107	17	10.705	— 156	9	..
West Ham	,, 25	4,902	+ 193	17	40,585	+ 1,125	14·7	..
Wolverhampton	,, 24	1,885	+ 90	16	14,454	+ 255	12·5	..
Yorks. W. Riding	,, 28	2,891	+ 649	30	33,617	..	..	..
Baker St.-Waterloo	,, 27	4,765	+ 2,162	..	..	..	4	·75
Cen. London Rly.	,, 27	10,802	+ 1,041	4	21,791	— 1,579	6	..
†Char. +, Eus. Hmp.	,, 27	5,100	..	4	10,445	..	8	..
City & S. Lon. Rly.	,, 28	6,311	+ 1,008	4	12,747	+ 2,610	7 3	1·15
Dublin-Lucan Rly.	,, 26	329	+ 28	..	..	..	7	..
G.N. and City Rly.	,, 27	3,803	+ 67	4	6,761	+ 127	3·5	..
G.N., P'dy. & Brmp.	,, 27	8,245	— 275	4	17,090	..	9	..
L'pool Overh'd Rly.	,, 28	3,608	+ 453	4	6,825	+ 552	2·8	4·3
Mersey Railway	,, 27	3,478	+ 115	4	7,349	+ 706	4·5	..
Metropolitan Rly.	,, 28	60,380	+ 825	4	62,490	+ 2,453	24·5	..
Met. District Rly.	,, 28	15,259	+ 118	4	31,598	+ 9	24	..
Anglo-Argentine	,, 22	16,538	+ 2,281	29	477,960	+ 48,857	43	..
§Auckland	,, 19	10,168	+ 849	28⅔	74,705	+ 2,968	19·2	·56
§Brisbane	June	12,500	+ 905	..	..	..	..	..
§Brit. Columbia Rly.	..	27,211	+ 3,743	52	298 574	+ 64,722	..	..
Bu'n's A'r's E.T.Co.	Mar. 2	3,947	+ 290	9	14,647	+ 1,859	..	..
†Bu'n's A'r's-Bigr'no	Apr. 21	3,911	+ 314	16	60,228	+ 4,091	..	..
Calcutta	July 27	9,872	+ 611	..	..	..	..	..
§Cape Electric T. Ld.	May	12,710	..	..	..	..	..	..
§Geneva	June	8.340	+ 435	..	..	..	..	..
§Kalgoorlie, W.A.	..	4,207	..	25	23,752	..	20·5	..
Madras	July 15	7,540	+ 170	28	24,706	+ 2,002	12·75	2·25
‡Lisbon	May	896	..	..	..	..	..	..
Perth (W.A.)	July 26	2,755	— 99	30	42,986	— 1,470	26·6	·4

* Compared with the corresponding period of 1906. † One week only.
‡ Includes horse, steam and other receipts § One month.

STOCKS AND SHARES.

Tuesday Afternoon.

After the latest blow administered to the price of Consols, it follows that the comments upon investment stocks generally will have to be couched in a low key—temporarily, at any rate. This is scarcely the place to enter upon dissertations concerning the causes of the fall in gilt-edged securities, but, of course, the collapse has affected investment stocks all round, and even where quotations have not been altered, the seller finds now that he is at a decided disadvantage.

Hanging to the skirts of the falling Consols, the Home Railway market approaches a state of demoralisation. The only comfort about this unhappy condition is that few proprietors want to sell, and prices give way, as it were, of their own weight. And no buyers are abroad: that is the secret of the trouble. Leading companies are eager to get on with pressing demands for electrification work on their suburban systems, but almost every new loan or company which appears is received with public indifference, and only in cases of immediate necessity do borrowers dare to appeal for fresh capital. Hence electrification is retarded and the public convenience of travel has to suffer.

Two or three South African municipalities have lately braved the public apathy and brought out new loans, the prospectuses in each instance putting electrical work—lighting, power and tramway—in the forefront of the catalogue of needs for which the money is required.

Satisfaction was expressed at the Central London's announcement of a 3 per cent. dividend on the Ordinary stock. No change has occurred in the trio of quotations. City and South London Ordinary remains at 47 middle. There has been a fresh lapse in Metropolitan Consolidated stock to 44 and in Districts to 12, these movements being due more to sympathy with the rest of the market than anything else. Metropolitan is *ex* dividend this week: poor little 5s. per cent.!

Electricity Supply shares have hardly moved a fraction, with the exception of the Charing Cross Preferences, both sorts being marked down ¼ each. The dividends which have been declared are up to expectation, but the market continues clogged by public suspicion, and there is no buoyancy throughout the list. Debenture stocks hold their position with firmness, notwithstanding the slump in gilt-edged issues.

Directly the meeting of the Anglo-American Telegraph Company was over, a stampede ensued to sell the Deferred stock upon the chairman's statement respecting the depreciation upon the investments held by the company. The proposal to spread the loss over a period of three or four years did not suffice to save the Deferred stock from slumping to 18⅜. At first, some measure of comfort was derived by the consideration that a possible improvement in the prices of Consols and so forth would save the company writing off the whole £80,000 estimated by the directors, but, of course, this idea went to the winds as Consols dropped lower than ever.

Other movements in this department are without importance. Direct Spanish Preference were advanced ¼ upon a quite moderate inquiry, and West India and Panama Ordinary at 12s. 6d. were slightly easier. Other changes are confined to the prior-charge stocks, and call for no comment.

In traction descriptions the market has been exceptionally firm, and several improvements took place. Chief of these is a 3-point rise in the Deferred stock of the British Columbia Electric Railway. Anglo-Argentine Ordinary hardened again, and Calcuttas regained the ¼ lost last week. British Electric Tractions Preference were lowered to 7½, and after many days, Westinghouse Debenture rose, only a point, it is true, but still it rose, and the nominal price is now 61½.

Many people will have noticed, with reminiscence grave or gay, that the Electrobus Company is running omnibuses in London. The success of the vehicles will be a matter of general aspiration, if only as a sign of the cordiality with which any improvement would be welcomed upon the petrol motor-'buses with which the Metropolis is plagued and the shareholders are maddened.

British Thomson-Houston Debentures fell 2 to 89, at which the yield to an investor works out to 5 per cent. on the money. Brush shares were unaffected by the latest proposals for reorganising the capital, proposals which are not half drastic enough. Not many people can remember the palmy days when Brush shares stood at £80 apiece, when several suicides and many ruins occurred over the shares, when company after company was floated to deal with the patents in various English counties, when ——— But, perhaps, it were kinder to ring down the curtain at this point.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations July 23rd.	Closing Quotations July 30th.	Business done week ended July 30th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3⅛	3 — 3⅛	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
660,660	Anglo-American Telegraph	Stock	6ls.	2½%	3½%	3½%	62 — 65	62 — 65	63½	62½	..	5 19 3
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5½%	6 %	6 %	109 —110	109 —110	110	109½	..	5 9 1
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	½%	1¾%	20⅜— 21⅛	18⅛— 19	20⅜	19	—2⅛	9 4 3
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	..	101 —104	101 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6⅞— 7⅛	6⅞— 7⅛	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	..	..	..	4 5 1
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	7⅛— 8⅛	7⅛— 8⅛	7⅞	7⅛	..	6 1 8
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15⅛— 16⅜	15⅛— 16⅜	..	..	..	5 19 5
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8⅞— 9⅛	9 — 9⅛	..	..	+ ⅛	5 5 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101 xd	..	..	..	4 9 1
60,710	Direct United States Cable	20	3 %	3½%	4½%	4⅝%	15⅛— 16	15⅛— 16	15⅛	15⅜	..	5 19 6
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	98½—100⅛	99 —101 xd	..	..	+ ⅛	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock.	Stock	7 %	7 %	7 %	7 %	134 —139	134 —139	137	124	..	5 0 9
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	88 — 90	88 — 90	89⅛	..	..	3 17 9
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	103 —105	103 —105	104½	..	..	3 16 2
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13¼— 13⅜	13¼— 13⅜	13⅛	13⅛	..	5 2 9
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	104 —106	104 —106	105½	104	..	3 15 6
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98¼—100⅛	98¼— 100⅛	98½	..	..	3 19 7
181,127	Globe Telegraph and Trust	10	5½%	5⅝%	5½%	5½%	10⅞— 11⅛	10⅞— 11⅛	11	10⅞	..	5 2 4
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅜— 14	13⅛— 14	13⅛	13⅜	..	4 5 9
150,000	Great Northern Telegraph, of Copenhagen.	10	15 %	24 %	24%	20 %	34 — 36	34 — 36	37⅛	..	..	5 11 1
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	98½—100½	99 —101	..	..	+ ½	4 9 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	56— 58	56 — 58	..	..	..	5 12 1
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	66 — 68	66 — 68	..	..	..	5 2 11
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	67 — 69	67 — 69	..	..	..	5 15 11
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅜— ⅜	⅜— ⅜	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	..	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞— 1	⅞— 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 — 111	109 —111	110	108½	..	5 8 1
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5⅛%	108 —110	108 —110	109½	108	..	5 0 0
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	11¼— 13½	11¼— 13½	..	..	..	4 8 11
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	11¼	..	..	4 8 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 3/16— 5 1/16	5 3/16— 5 1/16	5 1/32	..	..	4 7 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	96	..	..	3 1 10
1,689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	102	..	..	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6½%	6½%	7 %	7 %	1⅞— 1⅞	1⅞— 1⅞	..	..	..	5 1 10
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1 3/16— 1 1/16	1 3/16— 1 1/16	..	..	..	4 11 5
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	93 — 96	91 — 94	90	..	—2	4 5 1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..	4 10
3,167	Submarine Cables Trust	Cer	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..	4 12 4
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	7 — 7½	7 — 7½	..	..	..	5 6 8
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5½	5 — 5½	..	..	..	4 10 11
15,609	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10½	..	..	..	3 16 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1⅛— 1⅜	1⅛— 1⅜	..	..	..	3 12 9
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	3 18 5
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930. ..	10	7 %	7 %	7 %	..	13⅜— 14⅛	13⅜— 14⅛	13 11/16	13⅜	..	4 19 1
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅞— ⅞	7/8— 15/16	8/9	..	— 1/16	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7⅛— 7⅜	7⅛— 7⅜	..	..	..	10 5 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6⅝— 7⅛	6⅝— 7⅛	..	..	..	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100 —103	99 —102	99	..	—1	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	8 %	8 %	8 %	8½— 8⅝	8 7/16— 8 13/16	8 7/16	8 7/16	+1/16	4 12 1
260,077	Do. 5½ % Cum. Prefs., 1 to 260,077 ..	5	5½%	5½%	5½%	5½%	6 — 6⅛ xd	6 — 6⅛	6 3/16	6 1/16	..	4 8 0
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	131 —134	131 —134	..	..	..	4 9 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 8
880,000	Babcock & Wilcox, 1 to 530,000	1	17 %	20 %	20 %	20 %	3¾— 4⅛	3¾— 4⅛	81/1½	77/6	..	4 19 6
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..	3 7 7
38,000	British Aluminium, Ord., 2,001 to 40,000 ..	5	..	7 %	7 %	7 %	4¾— 5¼	4¾— 5¼	..	..	..	7 0 0
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	5 — 5⅜	5 — 5⅛	5 3/16	..	..	6 7 3
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..	5 9 1
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3¾— 4¼	3¾— 4¼	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	98 —101	98 —101	99⅜	..	..	5 8 11
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	123 —128	127 —132	131	..	+4	4 10 11
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	108 —112	110 —114	111¾	..	+2	4 7 9
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	101 —104	103 —106	..	..	+2	4 14 4
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250 ..	40	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103	100 —102	100	..	— ½	4 8 3
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	2½— 3	2½— 3	..	..	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	7⅛— 8	7⅛— 7⅞	7⅞	7⅞	— ⅛	7 14 10
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	100 —103	99 —102	101	..	—1	4 18 0
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	78 — 81	78 — 81	..	..	..	5 11 1
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6⅞— 7¼	6⅞— 7¼	..	..	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5¾— 6⅛	5¾— 6⅛	..	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	101 —104 xd	101 —104	..	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	89 — 93	87 — 91	..	..	—2	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1⅛	1 — 1⅛	25/3	..	..	Nil
1,016,358	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	58 — 63	58 — 63	..	..	..	6 7 0
50,000	‡ Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	11/16 — 13/16	11/16 — 13/16	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	⅜— ½	⅜— ½	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	⅝— 1⅛	¼— 1⅛	..	..	+ ⅛	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	88 — 91	88 — 91	..	..	..	4 18 11
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	71 — 74	71 — 74	..	..	..	6 1 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4⅛ — 4⅜	4⅛ — 4⅜	85/7½	83/9	..	3 8 7
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	96/3	95/-	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	100	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
137,610	Calcutta Trams, 1 to 137,610	5	6 %	8 %	8 %	8 %	7⅛— 7⅜	7⅛— 7⅜	7½	7 5/16	+ ⅛	5 3 3
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	..	..	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..	4 8 11
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	102 — 106	102 —106	104½	..	..	4 4 11
35,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9⅝— 10⅛	9⅛ — 10⅛	10⅛	..	..	6 13 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	..	..	..	4 8 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105½—107⅛	105½—107⅛	..	..	..	4 3 9
491,222	Cape E. Trams., 1 to 491,222	1	10 %	5 %	Nil	..	1/16— 1/16	1/16— 1/16	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1⅛— 1 1/16	1⅛— 1 1/16	..	..	..	6 1 11
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102	..	..	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	73 — 75	73 — 75	74½	74½	..	5 6 8
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	..	..	..	4 5 1
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	55 — 56	55 — 56	53⅝	..	..	7 2 10
1,480,000	City and South London Railway	Stock	2⅜%	2½%	1⅞%	2½%	47 — 49	46 — 48	48⅛	46½	—1	4 8 7
85,000	Crompton & Co., Nos. 1 to 85,000	3	2½%	2½%	2½%	5 %	1⅛— 2⅜	1⅛— 2⅛	43/9	40/-	— 1/16	6 17 11
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	93¼— 96½	93¼— 96½	..	..	..	5 3 8

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations July 23rd.	Closing Quotations July 30th.	Business done week ended July 30th, 1907.		Rise + or Fall —	Present Yield per cent.
		*	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	6 3 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — 1¼	1 — 1¼	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	100 —103	101 —104	..	..	+1	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	13½ — 14½	13½ — 14½	..	..	..	4 2 9
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	13 — 14	13 — 14	..	..	..	4 9 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	N	2½%	4½%	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	9 1 10
17,139	Do. "A" shares, 01—017,139	5	N	2½%	4½%	..	2⅛ — 2⅜	2⅛ — 2⅜	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	83 — 85 xd	88 — 85	88½	88½	..	4 14 2
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 — 92	89 — 92	..	..	..	5 8 8
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	⅛ — 7/16	⅛ — 7/16	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	1⅛ — 1⅜	1⅛ — 1⅜	..	..	+ ⅛	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	92 — 95	92 — 95	..	..	..	5 14 8
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	2 — 2¼	2 — 2¼	..	..	..	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10¼ — 10½	10¼ — 10½	..	..	..	6 13 4
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11½ — 12⅛	11½ — 12⅛	..	..	..	6 0 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5¼	5 — 5¼	..	..	..	8 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105½ —107⅞	105½ —107⅞	107	105½	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	5 %	10%	10 %	15 — 16	15 — 16	15½	15	..	6 5 0
37,500	†Liverpool Overhead Railway, Ord.	10	18%	1½%	Nil	Nil	1⅛ — 1⅜	1⅜ — 2	..	..	+ ⅛	Nil
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	5 %	6⅛ — 7⅛	7 — 8	..	..	+ ⅛	6 5 0
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6⅜ — 7⅛	6⅜ — 7⅛	..	..	..	3 8 7
399,980	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6¼ — 7⅛	6¼ — 7⅛	..	..	..	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛ xd	..	..	..	5 14 8
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	84 — 88	84 — 88	85⅛	..	..	4 10 11
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	3/32 — 5/32	3/32 — 5/32	1/10⅛	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	15/32 — 17/32	15/32 — 17/32	18/6	18/1½	..	4 12 9
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97 xd	..	..	..	4 10 11
30,000	Peebles (B.) & Co., 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	3⅜ — 4½	3⅜ — 4	..	..	— ⅛	7 10 0
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	1/16 — 1/8	1/16 — 1/8	..	..	..	6 8 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 1/8	1/16 — 1/8	13/-	..	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	31 — 33	31 — 33	32½	31½	..	5 9 1
150,000	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	8 18 5
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	64 — 67	64 — 67	..	..	..	7 9
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1½ — 1⅔	1½ — 1⅔	30/-	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3⅝ — 4	3⅝ — 4	..	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..	5 0 0

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5⅛%	5⅛%	5⅛%	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	5 4 9
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	6 1 3
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	4 2 4
306,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	8 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3⅞ — 4	3¾ — 4	..	..	..	6 5 0
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4¼	3¾ — 4¼	77/6	..	— ⅛	5 5 11
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3¾ — 4	3¾ — 3⅞	..	..	— ⅛	6 0 0
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3¾ — 4¼	3¾ — 4¼	..	..	..	5 0 0
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	102½	..	..	4 5 9
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9 — 10	9 — 10	9 1/16	9 1/16	..	6 0 0
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	10⅜ — 11⅜	10⅜ — 11⅜	..	..	..	5 2 2
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —124	121 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	4⅜ — 5	4⅜ — 5	..	..	..	4 0 0
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅜ — 5	4⅜ — 5	..	..	..	5 0 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	7 — 8	7 — 8	7½	..	..	6 5 0
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅜ — 11⅛	10⅜ — 11⅛	..	..	..	5 4 4
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	94 — 97	94 — 97	95½	94½	..	4 12 9
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	⅛ — 1	⅛ — 1	10/-	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1 — 2	1 — 2	..	..	..	15 0 0
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81	76 — 81	77	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅞ — 5⅜	4⅞ — 5⅜	..	..	..	5 8 5
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 15 3
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	6 4 2
21,000	Kensington and Knightsbridge Electric Ord.	5	12%	12 %	10 %	10 %	8½ — 9⅛	8½ — 9⅛	..	..	..	5 0 0
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 5 1
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	5 12 3
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅛ — 5⅛	4⅛ — 5⅛	..	..	..	5 17 1
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	93 — 96	98 — 96	..	..	..	4 18 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	82%	10 %	10 %	8 %	5⅜ — 6⅜	5⅜ — 6⅜	6⅛	..	..	5 14 3
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 5 9
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	103 —107	103 —107	107	..	..	4 4 1
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	87 — 92	87 — 92	..	..	..	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	7⅛ — 7⅞	7⅛ — 7⅞	..	..	..	5 3 3
75,000	Do. 5 % Pref., 1 to 75,000	5	5 %	5 %	5 %	5 %	5 — 6	5 — 6	..	..	..	4 3 4
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	11½ — 12½	11½ — 12½	..	..	..	6 0 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6⅔%	7 %	7 %	7 %	5⅛ — 6⅜	5⅛ — 6⅜	..	..	..	5 9 11
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	8 — 9	8 — 9	8 7/16	..	..	5 11 1
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	4 13 4
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	86 — 91	88¾	..	..	3 16 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	⅛ — 1⅛	⅛ — 1⅛	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 — 77	73 — 77	..	..	..	5 3 11
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	1⅞ — 2⅛	1⅞ — 2⅛	43/9	..	+ ⅛	6 6 4
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅛ — ⅜	⅛ — ⅜	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 1 10
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	11 2 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2 — 3	2 — 3	..	..	..	8 6 8
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	9 — 10	9 — 10	..	..	..	6 0 0
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	5 — 5⅛	5 — 5⅛	5 5/16	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4 per cent., April 25th, 1907.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JUNE, 1907.

The above month's returns disclose a falling away in value, both in the case of exports and imports, to a lower level than has existed previously in 1907.

The exports and imports at £133,514 and £133,662 respectively, compare with totals of £161,250 and £147,001 in the two cases, for the preceding month.

The re-exports of foreign and colonial goods, on the other hand, have risen to £19,319, a figure which is the highest but one recorded in 2½ years, and is some £6,000 better than the May total. Having regard to the satisfactory returns shown in the preceding months of the year, this month's reduced export and import totals may probably be credited to temporary circumstances.

In spite of the above reduced values, such individual items as cable and machinery exports were well maintained; the import section also shows a small increase in telephone imports which amounted in all to £25,361 worth.

In regard to the latter, it may be noted that we re-exported some £11,329 worth of foreign-made telephonic goods during the month, the export of home-made telephonic goods amounting to only £2,618 in value.

The prominent purchasing and importing countries remained substantially as on previous occasions.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.*

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material, and electric bells.	Electrically-driven machinery	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	343	11,874	41	...	292	2,916	7	...	...	22	...
Germany	238	1,511	99	...	62	744	...	...	21	142	...
Netherlands	80	1,428	421	16	12	118	...	61	11	...	...
Dutch Borneo and Java	110	134	108	...	...	161	37	...	7	...	...
Belgium	195	380	67	63	212	526	9	50	1,049	45	...
France and French West Africa	259	...	31	8	...	2,158	130	...	...	323	...
Portugal, Madeira and Portuguese Africa ...	126	201	128	47	235	295	2	...	150	...	...
Spain and Canary Isles	6	2	9	78	...	3	...	...	9	...	...
Italy, Austro-Hungary, Greece and Turkey ...	307	...	77	325	14	844	...	...	...	...	...
Egypt, Tunis and Morocco	854	41	165	63	...	516	...	...	10	348	...
China and Siam	1,225	4,040	411	195	56	1,307	...	...	197	1,065	...
Japan	80	2,277	95	7	233	8,584	...	...	...	1,337	...
U.S.A.	298	...	69	...	42	312	...	...	...	...	...
Mexico, Colombia, Venezuela, Peru and Uruguay	241	...	131	...	31	27	419	...	...	...	...
Chile	65	163	113	234	52	1,721	174	4	67	...	...
Brazil	261	595	49	764	372	3,420	38	2	12	13	...
Argentine	291	1,618	511	161	81	1,846	16	...	289	...	...
Channel Isles, Gibraltar and Malta	65	316	128	...	...	509	...	...	...	...	...
British West Africa	...	...	21	...	31	335	3	...	12	...	...
Cape of Good Hope	881	726	92	273	23	902	99	42	60	17	...
Natal	837	3,340	221	590	5	5,361	60	21	169	67	...
Zanzibar, Brit. East Africa and Mauritius ...	13	4	70	28	...	...	4	...	16	...	...
India	833	4,736	1,204	761	516	3,244	679	10	65	714	91
Burmah	300	346	46	149	...	432	18	...	34	197	...
Ceylon	5	32	58	...	72	168	5	3	31	...	...
Straits Settlements and Fed. Malay States ...	12	774	260	91	219	374	48	66	118	118	6
Hong-Kong	65	4	251	102	85	1,148	36	26	...	3	...
West Australia	121	2,097	287	38	14	449	447	...	15	...	...
South Australia	122	1,824	...	...	...	540	...	...	...	...	...
Victoria	506	1,439	562	6	68	607	...	...	...	...	...
New South Wales	1,035	2,021	490	736	140	2,095	95	...	167	...	...
Queensland	6	...	37	...	108	...	...	...	...	...	...
Tasmania	1,313	...	9	...	...	20	...	...	...	...	...
New Zealand	322	2,775	773	214	13	2,026	123	6	109	...	...
Canada and Newfoundland	614	7,344	143	34	...	393	3	...	...	...	...
British Honduras, British West Indies and British Guiana	30	1	28	22	202	21	...	41	...	...	...
Total, £	12,059	52 043	7,185	5,005	3,190	44,122	2,452	332	2,618	4,411	97

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Russia, Norway, Sweden and Denmark	...	97	...	3	...	2,797	434	...	10,066	...	...
Germany	220	5,199	1,825	3,547	130	18,077	799	4,478	1,371	...	...
Holland	269	5,709	2,094	8,477	519	2,805	262	2,396	752	...	...
Belgium	239	2,041	...	3,667	383	5,129	206	991	12,261	...	...
France	187	3,973	3,580	31	865	2,709	378	2,751	610	246	...
United States	2,485	816	774	84	65	14,838	201	461	191	504	...
Canada	...	...	...	...	...	400	...	...	70	...	...
Italy	100	60	...	...	...	...	...	...	...	...	...
Total, £	3,500	17,895	8,273	15,809	1,962	46,755	2,280	11,077	25,361	750	...

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	2,724	391	629	1,160	18	2,671	10	238	11,329	149	...

Total Exports: £133,514

Total Re-Exports: £19,319

Total Imports: £133,662

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

* This section does not include telegraph cables and apparatus.

REVIEWS.

Gas and Oil Engines. By Horace Allen. Manchester: The Scientific Publishing Co. 1907. Price 12s. 6d. net.

One great advantage possessed by the author of this book is his intimate practical acquaintance with the cleansing and employment of blast-furnace gas for power generation, he having been so closely connected with the development of this branch of motive power from the early days. He is, therefore, well qualified on the subject of gas motive power, for all modern development of the gas engine may be said to have at its base that quality of producer gas of which blast furnace gas is the chief. But the book is by no means confined to this gas alone, or the engines on which it is used. Indeed, only a brief chapter is devoted nominally to blast-furnace gas, and that deals chiefly with the cleaning of the gas, an operation which, as the author well states, some firms attempted to ignore, and they had their trouble for their pains, to which we may well add it served them right for wilfully shutting their eyes to the only too obvious fact that a gas engine could never be expected to work when a great load of dust was being charged into the working cylinder.

The first chapter deals with the details of engines, with methods of calculating the same, and is followed by chapters on the application of the working charge, with particular reference to cycles and impulses, regulation and the inertia forces, fly-wheel, weight, &c. The author favours as the index of the compression curve the figure 1·35 for ordinary engines, and 1·32 when scavenging is practised.

Chapter IV treats of the various means of ignition, and contains also a useful power table for finding I.H.P. per lb. of mean pressure.

Following chapters treat of the mechanism of the gas engine, on cyclic irregularity, &c., and in Chapter IX various types of engines are described, and their details illustrated by some very clear sectional views, reference being made to super-compression or compression raised above the normal by admitting to the cylinder, air—already compressed above atmospheric pressure—at the extreme out position of the piston, whereby efficiency is considerably improved.

Figures are also given bearing on the benefit to be derived by introducing a fine spray of water with the object of employing some of the high temperature heat that would otherwise be wasted to the jackets or even at the exhaust. This, at least, is what a spray should do in our opinion.

A long chapter is given up to description of the vertical gas engine, a machine that does not make the advance that one would think it should do. Then follows a chapter, No. XI, on two-cycle engines, of which the Körting is a well-known example. Two-cycle engines involve the use of the piston itself as an exhaust valve, and a ring of exhaust ports to be uncovered by it, together with air and gas pumps to push in the new charges. While the explosions are doubled in frequency, the same power can be got from much smaller cylinders, which are more easily cooled by their jackets, and this serves to balance more or less the greater generation of heat per unit volume.

The next section of the book treats of the oil engine for use with crude or refined petroleum, and contains much information on distillates, and a classified list of engines on the basis of the method of vaporising the fuel. The use of a water spray is commended as an aid to perfect vaporisation of heavy oils, which then work as free from tar as refined oils of the kerosine type.

Naturally, vaporisers occupy much attention, and the Diesel engine, though a type by itself, necessarily comes into this section.

A chapter is devoted to marine engines, followed by one on carburettors for petrol engines.

In Chapter XXI the gas producer comes on the scene with illustrations of various producers, and the question of using bituminous coal is considered. The suction producer is treated of, and a good table of gas fuels appears. We commend the author's approval of large enough scrubbers, for there is a tendency to make them too small. This is a very good chapter.

Subsequent chapters deal with the cost of power, the indicator, the development of power by internal combustion engines, with a large number of statistical figures of physico-chemical value. The final chapters deal with the blast furnace, lubrication, exhaust utilisation, and the testing of gas and oil engines. Much of the book is, of course, compilation, but the value of a book may often be much influenced by the compiled portions, and in this case the compilation has been well done, and serves to round up this book into excellent form as a practical, sound work on its subject.

The Workmen's Compensation Act, 1906. Being the Ninth Edition of Willis's Workmen's Compensation Acts. By W. Addington Willis, L.L.B. (Lond.), of the Inner Temple, Barrister-at-Law. London: Butterworth & Co. Price 2s. 6d.

"Few persons," says the author of this work in his preface, "can afford to ignore the existence of the Workmen's Compensation Act, 1906, because, with comparatively rare exceptions, everyone who has left school comes within its provisions either as an employer or an employé." The appearance of this edition is welcome indeed. What, then, does the author attempt? He gives the text of the Act of 1906, with full and elaborate notes and numerous references to cases which, although decided under the Act of 1897, must still be of assistance in the solution of the many questions which will arise under the new Act. While all is excellent, there is one part of the work which appears to have been particularly well done—namely, the notes to the definition of the word "workman," which appears in Sec. 13 of the Act. In the luminous comments which the author makes in this regard, he points out that there are certain elements of doubt about the meaning of the words used. Thus, to touch upon a point which will have especial interest to readers of this paper, a person "whose remuneration *exceeds* £250 a year" is not within the Act, unless he is employed by way of manual labour. Supposing a man receives £200 from one employer, A, and £100 from another, B, and he is injured in A's service, can he claim compensation; or must the emolument which he receives from B be brought in to swell the total and exclude him from the benefit of the Act? There is a nut for a lawyer's crackers! Again, what is "manual labour?" The writer of this review is writing with pen and ink; is he engaged in manual labour? The meaning of manual labour has often been discussed in the Courts in the past, and if space permitted we might be able to give Mr. Willis's answers to the above question.

Mr. Willis's excellent work contains certain material sections of the Merchant Shipping Act, 1894; the text of the Employers' Liability Act, 1880, and an admirable index. We can confidently recommend it, not only to the legal profession, but to the millions of laymen who are so nearly affected by the provisions of the Workmen's Compensation Act, 1906.

Fuel, Water and Gas Analysis for Steam Users. By John B. C. Kershaw, F.I.C. London: Archibald Constable and Co., Ltd. 1907. Price 8s. net.

As fuels are so variable in quality and the efficiency of combustion is influenced by both the type of apparatus in which it is burnt and the conditions of air supply, its economical combustion can only be determined by ascertaining the initial heat value and comparing this with the temperature, specific heat, and weight of the products of combustion. It is not much gain to have an engine of high thermal efficiency if the initial stages of combustion or gasification of the fuel are wasteful and inefficient.

Mr. Kershaw's latest book is intended to supply the information, and to describe the apparatus necessary for the examination of the heat value of any class of fuel; the determination of the quality of water used for raising steam or other purposes, and the examination of the products of combustion to ascertain the conditions of air supply and the efficiency of the combustion.

As the title implies, this work is intended for the use of those engaged in the development of power by means of steam, and though many of the operations described require a considerable amount of skill and knowledge of quantitative

analysis, some of them can be carried out by any careful engineer.

Especially is this the case with the detailed instructions given for taking samples of either fuel, water, or gas, and when these have been followed the fee for the particular examination by a skilled chemist will be well repaid by the information resulting, showing how economy can be effected.

Part I deals with the origin and properties of natural fuels, with the methods of analysis and determination of heat value, and concludes with the practical application of the results.

Part II treats of water, its sources and characteristics, with methods of examination and the application of test results, and softening reagents.

Part III, on waste gases, describes the characteristics and methods of examination, as well as influence of the composition upon the efficient burning of the fuel. The appendix gives rules for sampling fuel and much useful information and tables relating to tests of fuel, water and waste gases.

There are 50 illustrations, and the whole work is of a thoroughly practical nature based upon extended experience.

As the proportion of volatile matter in fuel increases, its efficient burning with air in boiler furnaces becomes more difficult of accomplishment owing to its being accompanied either by the emission of smoke or by a thermal loss due to an excessive proportion of air; in either case there is a loss of heat.

The commercial value of fuel, therefore, cannot be judged by its gross thermal value, but must be found from an examination of the products of combustion resulting from the best conditions capable of being maintained in the apparatus in which the fuel has to be burnt.

THE ENGINEERING CONFERENCE.

(*Concluded from page* 129.)

The Welding of Structural Materials in Place.

Mr. H. A. Ruck-Keene's paper on this subject (Section V.—Shipbuilding. Friday, June 21st, 1907), served very well as a peg upon which a discussion might hang; but as a serious review of an important subject, it was but cursory. For instance, upon the subject of electric welding, there was presented a table of tests upon round steel and iron bars $\frac{1}{8}$th in. in diameter, welded by the Elihu Thomson process; the reader will find that the breaking stress of all the welded steel bars compares very favourably with the solid steel bar, but that the elongation varies between 42 and 65 per cent. of that of the original bar. No explanation of this is given, except for the remark "that the advisability of annealing is indicated." Similar discrepancies remain unexplained in the case of the iron bars, where, while the breaking stress is well maintained, the elongation again varies between 40 and 60 per cent. No explanation is given of this variation in regard to rate and conditions of cooling. Nor do we find any notes as to the micro-structure of the fractured surfaces, which would have permitted of comparison with known conditions. Other electric welding processes with carbon pencils or iron pencils are even more briefly dismissed, for no test figures whatsoever are given. Annealing is, of course, recommended.

The relative merits of electric welding processes must be of great interest to electrical engineers, as, quite apart from the welding of teeth into broken gear wheels, or of tramway rails, the faking up of steel castings for dynamos is an art which the steel founder occasionally practises. The molecular structure of electrically-welded steels may, therefore, be commended to those electrical engineers whose concern in metallurgical matters is not confined to the question of mechanical properties only.

Exact comparisons between the relative values of materials welded by blow-pipe processes (oxy-hydrogen or oxy-acetylene), or by Thermit processes, or by various electrical methods, are certainly called for. The author of the paper before us has failed to supply this want; are we to look to the National Physical Laboratory for an investigation? Even given the investigation, and granting the entire success of welding *in situ* so far as the actual physical juncture of metal with metal is concerned, will somebody tell us how the necessary annealing in place is to be secured, when arc methods of welding have been employed?

Discussion.

Several members asked for information as to the nature of the repairs for which the electrical and other processes described could be used, and as to cost, &c.

Mr. List asked the author whether the electric and oxy-acetylene processes could be used in repairing the stern frame of a ship. Every one who had to do with the repairing of ships knew what a troublesome business that was. He had witnessed the experiments in Thermit welding, and it had struck him that the results were not all that one could wish. There was no doubt that a satisfactory process of making welds in place would be exceedingly valuable.

Mr. Edwards thought that the process should be of great value for boiler repairs, which would be effected with ease as compared with the work of getting patches fitted and made watertight. He inquired whether there was any plant at work in this country of which he could avail himself. He would also like to know whether it was possible to renew a whole furnace crown, or the greater portion of it, by this process.

Mr. Wallis-Jones said that the Thomson process, after a very long period of experimental work, had proved very successful. It was largely used for welding tramway rails. In the United States over 300 miles had been dealt with by the process, and there were many such joints at work in this country. It had been found that it was necessary to make the weld under considerable pressure, and to leave the welded portion under pressure for several minutes.

Members also asked for information as to the necessity of annealing and as to the applicability of the process to copper and cast iron.

Mr. Ruck-Keene, in reply, said that he did not think sufficient experience had yet been obtained with the electric or other processes to enable a pronovncement as to the feasibility of welding a stern frame or other large section, or renewing a furnace crown satisfactorily; but smaller repairs by the electrical and oxy-acetylene processes had given very good results, especially as regards boiler repairs. He could not give any figures as to the cost of the electrical process, but with regard to the oxy-acetylene process he could instance two cases. In one 18 corrugated furnaces were badly wasted at the line of fire bars; the wasted parts were filled up to the original thickness by the welding process, at a cost of £480. The time taken was one month, and 2 cwt. of steel bar, 300 cubic metres of dissolved acetylene and 300 metres of oxygen were employed. In the other case 100 cracks in a furnace were welded up. The work took three weeks and cost £60. The oxy-acetylene outfit was very simple. A cylinder of dissolved acetylene and a cylinder of oxygen would cost about £7 or £9, but this would not include the blowpipe. For boiler work dissolved acetylene was more usually used than generated acetylene as being more portable. The cost of welding a half-inch plate with oxygen and dissolved acetylene was about 1s. 10d. per running foot for the gases used. To this must be added the cost of labour of one man, say, 9d. or 10d. per hour, in which time he should weld 5 to 6 feet. Explaining the figures in the tables of tests, he said that the contraction of areas there given was the contraction in the way of the break; some broke at the weld and some away from it. He understood that the electrical process had been satisfactorily employed for repairs to copper pipes, &c., and the oxy-acetylene process had been used for that purpose. The latter process had been used for cast-iron, but there was a risk owing to contraction, cracks being sometimes set up by the intense local heat. As to annealing after welding, this could partly be done by heating the parts adjoining the weld with the blow flame to a red heat and allowing them to cool gradually.

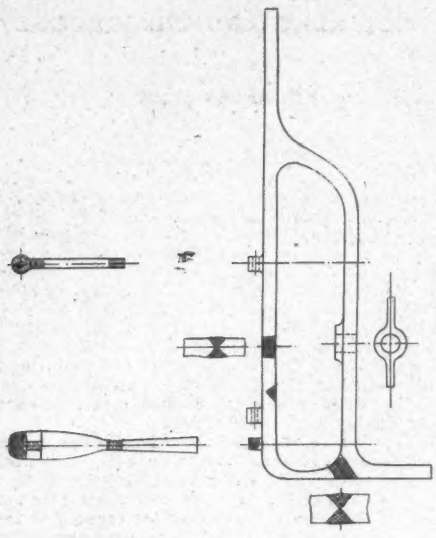
The figures of a later test for the welding of steel plates were read by Mr. Ruck-Keene, and are as follows:—

	Breadth	Thickness	Area	Tons per sq. in.	Percentage extension.
Not annealed	1·5 in.	·62 in.	·93	24·5	30 % in 4 in. Solid plates.
Annealed	1·5 in.	·62 in.	·93	24·0	36 % in 4 in. Solid plates.
		Oxy-Acetylene Welding.			
Not annealed	1·5 in.	·62 in.	·93	24·6	28 % in 8 in. Broke away from weld.
Annealed	1·5 in.	·63 in.	·945	23·3	29 % in 8 in. Broke away from weld.
	Cold bends: not annealed, 180°; annealed, 180°.				
		Electric Welding.			
Not annealed	1·0 in.	·56 in.	·56	27·4	12 % in 4 in. Broke through weld.
Annealed	1·0 in.	·56 in.	·56	26·3	14 % in 4 in. Broke through weld.

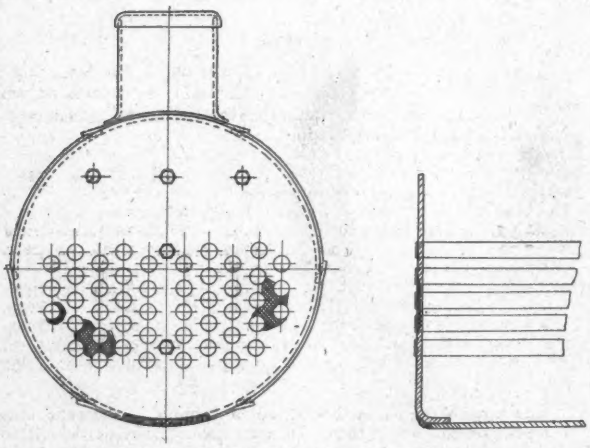
Cold bends: not annealed, 58°; annealed, 160°. Showed sign of fracture at weld.

A number of drawings were handed round showing repairs effected by the electrical and oxy-acetylene processes. We repro-

duce examples. One, it is to be noted, shows repairs as having been effected to portions of a stern frame.



Stern-frame Repaired in Place.



Repairs to Boiler Tube-plate and Shell.

With reference to the above paper, electric welding for ship repairs appears at present to be carried on at Gothenburg by the Electric Welding Co. of that place. The plant used consists of a transporting barge containing two dynamos of 45 KW. driven by steam, and a third dynamo of 3 KW. for the magnets. The pressure used is between 80 and 120 volts, depending upon the nature of the work to be carried out. Direct current is employed. No details of cost are at present available, but with reference to the Thomson process the Electric Welding Co., Ltd. (owning the patents for this country) publish figures which show that while the cost of electric welding is much less than that of forge welding, the output is very much larger. With arc welding the following figures have been furnished us by Mr. R. Wallis-Jones as illustrating the time occupied in making various kinds of welds, and the current employed:—

Filling up holes in castings—

1 cubic inch cavity can be filled up in about 7 minutes, using 300 amps. at 80 volts.

Seam welding in No. 14 steel—

2-ft. seam welded by two men in 15 minutes; current about 200 amps. at 80 volts.

Plate welding—

⅜-in. plate welded at the rate of 1 ft. in 14 minutes, using about 250 amps. at 80 volts.

Electro-Metallurgy.

Mr. Bertram Blount submitted to Section IV ("Mining and Metallurgy." Friday, June 21st) a note on "Electro-Metallurgy." He pointed out solid progress due to the discarding of merely laboratory processes, and the study of this branch on the practical lines of chemical engineering. The principal electro-metallurgical industries—copper refining (as distinct from copper winning), the manufacture of aluminium, of sodium, and of steel, were passed briefly in review; the last, the author expected, would become the largest industry of them all, but it was only now being developed.

Although the centre of interest of the electro-metallurgical industries in this country still lies in the future rather than in the present, the general tone of the discussion which followed the reading of Mr. Blount's paper was eminently gratifying, as showing that the "practical" man, the engineer and metallurgist, is now beginning to take electro-metallurgy a little seriously, and to ask himself—this is most hopeful of all—whether *his* particular work may not perchance be able to derive some benefit from further applications of the new and unfamiliar methods. Even the central station engineer is speculating on the possible relations between electro-metallurgy and the load factor, although the view which was put forward by more than one eminent expert at the Conference, that there is little to be hoped for from electric heating or smelting, except where fuel is dear and water power cheap, is one that is too often lost sight of in this connection. Perhaps this opinion is an extreme one, as the case of the Castner-Kellner works referred to by Mr. Campbell Swinton proves, and there are undoubtedly many instances in which, at least for subsidiary purposes, electric furnaces or electrolytic processes could be worked from the ordinary supply mains with advantage both to the manufacturer and to the generating station. Moreover, in the case of such a special manufacture as that of high-grade steels, there is a very general consensus of opinion that the advantages, particularly with regard to ease of control, offered by electric furnaces will ensure their replacing present methods of refining, even where the cost of power is a factor to be reckoned with. Particularly must this be the case where the gases from adjoining blast furnaces can supply all the power necessary for the purpose. But when all is said, cheap, abundant, and constant water power must always remain, at least until the ideal gas driving the ideal engine appears, the most important condition necessary for the successful application of electro-metallurgical methods to the greater of the metal smelting operations, to the manufacture of pig-iron or the smelting of copper or aluminium, in spite of the suggestion that aluminium works might take current from a central station supply. Until this fact is clearly recognised, there is likely to be spent much money and much endeavour in directions that were best avoided, to the detriment of legitimate progress on sound lines, and discussions such as are afforded by an Engineering Conference are amply justified if they bring into clearer relief a fundamental truth like this.

Discussion.

Mr. Thomas Parker said he had been engaged and interested in this subject for many years past. He referred to his work in connection with the electrolytic manufacture of phosphorus and to his invention of a process for chlorate of silver, now being used abroad. In this matter cheap current was of first importance. There was no hope that steam would compete with water power, but large gas engines might do so. But a satisfactory gas must be found, and he did not see a solution of the question in blast furnaces. When Coalite was generally used gas would be cheap enough, for it would cost less than nothing.

Mr. McLaren confined his remarks to copper smelting. The conditions and difficulties must be recognised—in particular that the valuable part of the ore was small in relation to that in iron smelting. The loss of copper at high temperatures was therefore important. The slag must be very fluid, and its specific gravity as small as possible. The electrical process could only compete where fuel was expensive and water-power available. The oxidised ores only were on the surface; deeper down were the sulphides, and those were what they wanted to get at.

Mr. Rathbone, as a mining engineer, asked whether there was any other aluminium ore except bauxite that could be used in the electrolytic extraction of aluminium.

Mr. Price desired to call attention to the omission of one important industry, namely, tin regaining. He spoke of the early days of electrolytic copper refining, when the gold and silver in the crude copper paid for the process; and he asked for information as to the use of magnetic separators in treating copper ores.

Mr. Harbord said that a special field was opened for the electric furnace in the treatment of iron sands in Canada and New Zealand. For pig-iron it could not be a competitor with the blast furnace, unless cheap water-power were at hand. It might be useful for making special steels of high quality, *i.e.*, not as a cheap melter,

but as a cheap refiner. The molten steel could be passed into the electric furnace for the final process. There was little chance for the use of blast furnace gases outside the works themselves. The mere quantity was insufficient for outside industries. The economy of water-power was greatly exaggerated, save in one or two places, as at Niagara. In many places it was only available nine months in the year.

Mr. A. A. Campbell Swinton remarked on the utility of electrochemical and metallurgical processes for improving the load factor of central stations, as was done at Carville, where the Castner-Kellner works were supplied very cheaply. Similarly, aluminium works might be established with the same view, where the cost of current was not great. In any case, it would pay a station to supply such works even at cost price, in order to improve the supply generally. A special form of electric furnace was the arc furnace, and in connection with that subject he might refer to the high temperature which could be attained in a vacuum tube by the impact of cathode rays. There was no reason why this should not be done on quite a large scale to melt substances otherwise refractory. Already Messrs. Siemens Bros. used the method in the manufacture of tantalum lamp filaments, and he looked forward to thousands of horse-power being expended in vacuum tubes.

Mr. Mordey maintained that it was vain to look to metallurgical processes to improve the load factor, since it would be cheaper to set up private plant for an all-day load than to take it from the power station; and even were it so taken the station would have to set aside a certain part of its plant for the purpose.

Prof. Turner (Birmingham) said that 33 per cent. of the power of blast furnace gases would be available for outside use. Iron works were generally in a populous district, so that there would be no lack of industries to which the power might be supplied. But the whole of the fuel in the furnaces was but 10 million tons a year, only 2½ per cent. of the consumption in this country; and the power so obtained would be almost negligible compared with the total power required.

Mr. Bailey referred to a case in which he had built up the journals of a Cornish engine electrically, and then machined them.

Mr. Wingfield noticed the omission from the paper of any reference to the application of electric methods to "high speed" steels, tungsten, &c.

Dr. Mollwo Perkin followed on the same lines, asking where graphite, carborundum and metallic calcium had gone. The question about calcium was to find a use for it. It might be a substitute for aluminium in the Thermit process, especially since it would remove nitrogen as well as oxygen. Want of co-operation between engineers and chemists was the chief hindrance to advance in electro-metallurgy. An engineer could not expect to be an expert chemist, nor a chemist an expert engineer. The calcium carbide industry had almost left this country. Carbide could be used to manufacture cyanamide, which should be a paying industry. As to cathode rays, with thousands of horse-power behind them, he anticipated difficulties in keeping the vacuum.

The Chairman (Col. Crompton) said that the discussion was of the very kind aimed at by the Conference. Engineers and chemists had alike contributed to it. Mr. Harbord's contribution to the debate suggested a very admirable method of utilising the expensive electrical energy to the best advantage. In some things, such as tempering, success depended on very accurate control of the temperature, and it was a great point gained when the same means provided the heat and the control, as was the case with electric heating. He thought that the big internal-combustion engine was not at present a satisfactory tool, and he was persuaded that there was still an enormous deal to be done with steam at much higher temperatures than now obtained.

Mr. Blount, in his reply, said he was much interested in Mr. Parker's early experiences, especially as regarded silver chlorates. His paper was rigidly restricted to *metallurgical* work, therefore graphite, carborundum, &c., were deliberately omitted. The third part of 10 million tons per annum meant something enormous in horse-power, and it was not sufficient reason for wasting it that it was relatively small. He was careful to confine his remarks to electric smelting of copper as distinguished from electric winning. Bauxite was at present the sole source of aluminium, but there was reason to suppose that corundum, laterite, and even clays might be available, especially if a use were found for aluminium not chemically pure, or an impure aluminium might be extracted from clay, &c., and afterwards refined electrolytically. He had found no space to refer to the electrolytic treatment of lead, nickel, &c., and the recovery of tin was too small an industry to be noted. In reply to Mr. Harbord, he said that titaniferous ores could be treated by electro-metallurgical methods. As for the improved load factor, he thought some compromise was possible, and that electrochemical works might prefer to be rid of the trouble of an electric plant and to take current from the public mains, perhaps avoiding the peak. The hardening of the steel found by Mr. Bailey might be due to its taking up carbon from the arc. The idea of big vacuum tubes was fascinating; it was for engineers to find out how to retain (or renew) the vacuum.

Barnstaple Electric Lighting.—The T.C. has decided to supply electricity to the works of Messrs. Miller Bros. at 2⅜d. per unit, and to Messrs. Shapland & Petter at the following scale: First 5,000 units per quarter, 2d. per unit; over 5,000 to 7,000, 1½d.; over 7,000 to 10,000, 1¼d.; beyond, 1d.

THE ELECTROSTATIC CAPACITY BETWEEN A VERTICAL METALLIC CYLINDER AND THE GROUND.*

By A. E. KENNELLY and S. E. WHITING.

(*Concluded from page* 154.)

The resistivity of the solution was measured in two ways: first, by filling a glass tube 23·5 cm. long, and 1·129 cm. in mean internal diameter, with the solution, and plugging the ends with rubber stoppers, carrying copper-plated faces connected to the Wheatstone bridge by insulated wires, and measuring the resistance of the column of solution in the tube after its temperature had become practically the same as that of the solution in the tub; secondly, by suspending a copper-plated brass sphere, of radius 0·95 cm., in the solution, by an insulated wire, at a measured height above the centre of the disk in the tub of solution, and measuring the resistance between the sphere and disk by Wheatstone bridge to "false zero." The results by these two methods agreed satisfactorily, and the mean was taken of $\rho = 99$ ohm-cm.

Table I gives a comparison of the capacity in air to ground of a vertical cylinder of various lengths according to formula (8), and also as inferred from the conductances indicated in fig. 5 reduced by the use of formula (4). The first column gives the height of the cylinder. The fourth column gives the capacity of the cylinder according to formula (4). The fifth column gives the capacity of the cylinder as deduced from conductance measurements with the tub model. The last column gives the ratio of these two capacities. It is evident that the conductance model must give larger capacities

Table I.

Capacity of a Vertical Cylinder to Ground, in Air, According to the Formula for a Remote Ellipsoid, as Compared with Measurement on the Small Conductance Model. Diameter of Cylinder, 100 centimetres.

Cylinder height l cm.	$\frac{l}{d}$	$\frac{l}{r}$	Ellipsoidal capacity c abstatfarads.	Capacity deduced from model c' abstatfarads.	Ratio. $\frac{c'}{c}$
8,000	80	160	788·0	857·8	1·089
7,000	70	140	708·3	775·8	1·095
6,000	60	120	626·4	696·2	1·111
5,000	50	100	542·8	615·0	1·133
4,000	40	80	456·4	529·8	1·161
3,000	30	60	366·4	436·0	1·190
2,000	20	40	271·0	333·5	1·230
1,000	10	20	166·9	217·6	1·304

than those obtained by the ellipsoidal formula, if the conductance measurements are reliable; because the capacity of the cylinder must be greater near the ground than in free space remote from other conductors. According to these measurements, however, the capacity of a cylinder 80 diameters in height is only 8·9 per cent. greater near the ground than in free space, while even if the height be reduced to 10 diameters, its capacity is only 30 per cent. greater near the ground than in free space.

The fact that the increase in capacity of a long cylinder is not very large when brought near to the ground at one end is explained by an examination of fig. 2, which shows that the fall of electric

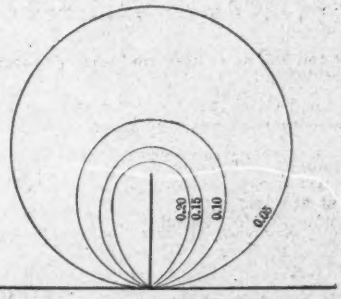


Fig. 6.—Approximate Contours of Equipotential Surfaces Surrounding Vertical Cylinder Conductor. Length of Conductor, 10 cm.; Diameter of Conductor, 0·25 cm. Distance from Conducting Plate, 0·2 cm.

potential due to ϕ R drop, where ϕ is the electric flux and R the dielectric resistance, is relatively large in the immediate neighbourhood of the cylinder. If the first ellipsoidal shell, marked as having a potential 0·38 of that at the cylinder, were grounded, so as to reduce its potential to zero, the capacity of the cylinder would only be increased 61·3 per cent., and in that case the cylinder would be

* From the *Electrical World and Engineer* (slightly abbreviated).

virtually brought near to the ground at all points and not merely at one end. Consequently, when the ground is brought near to the cylinder at one end only, the increase in capacity must be much less than 61·3 per cent.

The conductance measurements in this case did not admit of a high degree of precision for several reasons. First, because the dimensions of the copper disk at the bottom of the tub were too small to represent the effect of an indefinitely extended plane. The conductances and their deduced capacities, were, therefore, somewhat too small, especially for the greatest lengths of exposed wire. Secondly, it is difficult to avoid errors in the measurement of a resistance containing a C.E.M.F. of polarisation, even when working to polarisation-zero. Moreover, if the polarisation varies with the current density, some variation of the polarisation E.M.F. may have developed at different portions of the exposed surface. Consequently, the conductance measurements here presented may be several per cent. in error. However, the results may be safely regarded as indicating that in the case of a vertical insulated cylinder near the ground, having a length of a hundred or more diameters, its capacity will be only a few per cent. greater than that obtained by the use of the ellipsoidal formula (4).

By means of the exploring electrode F (fig. 3), consisting of a copper wire sealed in a glass tube, and adjustable in its position relatively to the immersed wire W, the potential distribution in the liquid could be explored. The observations, as far as a potential of 20 per cent. of the potential at the vertical wire W, are outlined in fig. 6, p. 199.

THE PROPAGATION OF ELECTRIC WAVES.

By W. M. M.

The main purport of this article is critical. It is only in a slight degree constructive, and that tentatively. It is a statement of the difficulties of a student who wishes to believe what he is told, but wants also to know what, and why, he believes. In the multitude of counsellors he finds confusion, and in trying to clear this up to himself he has hit upon a new way of looking at the subject—new, at least, to him. Possibly it may be a help to others who share his difficulties.

In the course of a slight excursion into the wide field of recent literature on the subject of wireless telegraphy, I found that at one particular point the author, whoever he might be, became a little vague and figurative in his explanation. That point was the detachment of the electric lines of force from the oscillator and their propagation into space. A few quotations will illustrate how great is the need for more exactness in describing the phenomena, or, a possible alternative, more candour in admitting that they are imperfectly understood.

Prof. Mazotto writes—I quote from the English translation:—

> But if the discharges take place with that extraordinary rapidity which characterises the Hertzian electrical oscillations, the phenomenon changes character; the lines of force which in the case of charges which are stationary, or charges which discharge at a slow rate, rest always with their extremities in the conductors, in consequence of the violence of the discharge, detach themselves from these, and close in upon themselves as shown in fig. 37, *and propagate themselves into space with the velocity of light*, carrying with them the energy *arising from the tension of the ether enclosed by them*,

Mr. F. K. Vreeland tells us that "As the frequency increases, the increasing magnetic energy of the field unites with a portion of the electrostatic energy and is radiated into space never to return." He also reproduces the familiar diagrams of Hertz, and explains how:—

> In fig. 90 the reversed set of tubes are beginning to expand, forcing the detached wave outwards, and flattening it on its inner side.

Later he explains that only the outer tubes are "snapped off," and that it is very much a matter of luck:—

> The *chances* of a tube being snapped off depend on the wideness of the circuit that it makes. . . . Again, the number of tubes snapped off depends upon the suddenness of the snap.

He illustrates his point by reference to "the boyish game of 'snap-the-whip,' *where each boy represents a tube*." I am afraid that illustration would not help me much, even if I knew the game. A comparison to vortex rings in air is still more puzzling, for the two things have hardly any point in common. A vortex ring moves in the direction of its axis, the direction of rotation round its rim is continuous, and the air (or smoke) in the ring remains the same and changes place bodily. A closed Faraday tube moves perpendicular to its axis. The strain (or motion) in it is along the ring, and no one has ever suggested that the actual ether around Poldhu travels away to strike against a Marconi mast elsewhere—Prof. J. J. Thomson, however, tells us that a Faraday tube attached to a moving particle drags with it some of the ether associated with it. Possibly, therefore, the same thing may occur with a closed Faraday tube.

I turn to Prof. Fleming for enlightenment and find a very explicit statement, made more luminous still by illustrations, which I venture to reproduce. Regarding a Hertz oscillator as a condenser, Prof. Fleming writes:—

> When the spark passes, this condenser begins to discharge with oscillations. The ends of the lines of electric strain begin to contract inwards, and then are re-established in the same form, but in opposite directions, when the charges have changed places.
>
> If this exchange of position of the electric charges on the two rods were executed slowly, the oscillatory discharge would consist in the lines of electric strain collapsing inwards, and then being re-created in an opposite direction. If, however, the oscillations are sufficiently rapid, the lines of strain are unable to accommodate themselves quickly enough. Each line, or rather the medium in which it exists, possesses an inertia, and the lines of strain cannot instantly be annihilated or re-created in any place. Hence it follows that there is a decussation or crossing of some of the lines of strain during the discharge, and at various stages the disposition of the strain lines may be represented by the diagrams in the figure.

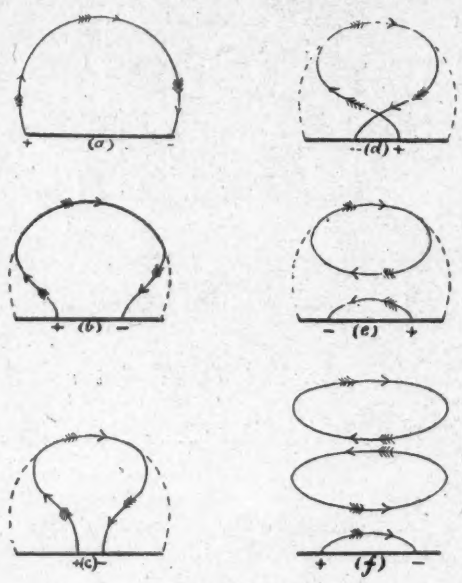


Fig. 1.

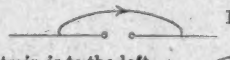
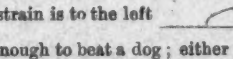
> When this decussation takes place, the line of electric strain is *nipped off* at the crossing point, and part of it is detached as a closed loop of electric strain. This process is repeated at each alternation, and results in throwing off normally from the rod self-closed lines of electric strain, the direction of the strain in the successive loops being alternately right-handed and left-handed, as shown by the arrows.
>
> As each loop is formed it is *pushed outwards* by the birth of a new one, *and this process constitutes electric radiation.*

It is to be presumed that by "a line of electric strain," Dr. Fleming means what is generally called a line of force. Certainly Mr. Vreeland in treating of the same problem so regards these lines, for he calls them "Faraday tubes." But, if so, it is not easy to see how they can ever cross as in fig. (*d*). A line of force is primarily the orthogonal trajectory of a series of equi-potential surfaces, and though it has since been endowed with many other properties, none of these is inconsistent with this primary definition. There is, then, in a line of force a continuous fall of potential from one end to the other along the line, and though it is conceivable that such an earthquake as the passage of a spark may buckle the equi-potential surfaces a bit, I cannot picture to myself a state of things in which there should be two different potentials at the same point, and at the same time. It might be replied that the point of crossing is always on the surface of zero potential; which is true, but then what becomes of the continuous fall of potential along the line? Moreover, *before* the head is nipped off we shall have two zero-potential surfaces crossing at an angle. It is a severe strain on the imagination to picture a possible conformation of the neighbouring equi-potential surfaces positive and negative so arranged that they also do not intersect. If, on the other hand, the lines of electric strain are not lines of force, or become something else in the course of their travel, there is a need of definition to tell us what they are.

It is noteworthy that Mr. Vreeland describes the same phenomenon quite differently; his lines never cross:—

> The opposite sides of the loops are drawn together by their mutual attraction, so that the tubes take a pear shape, and the sides finally meet and coalesce. The outer loops of the tubes then separate and go off by themselves, repelled by the inner portions, which now draw up to the oscillator until their ends meet.

Hertz's account is practically the same:—"Here there arises a peculiar action. . . . The lines of force which have withdrawn furthest from the origin become laterally inflected by reason of their tendency to contract together. As this inflection contracts nearer and nearer to the z axis a portion of each of the outer lines of force detaches itself as a self-closed line of force which advances independently into space, while the remainder of the lines of force sink back into the oscillatory conductors."

In Mr. Vreeland's shrinking tube the direction of strain is to the right, so  Dr. Fleming's tube is expanding and the strain is to the left  But any stick is good enough to beat a dog; either strain is competent to give the kick off which, in Dr. Fleming's words, "constitutes electric radiation." Mr. Vreeland escapes the difficulty of crossing equi-potential

surfaces, but he has another all to himself. At the moment when the sides touch, before the loop is cut off, the direction of the lines of force at the point of contact is perpendicular to the line of the oscillator. Hence the surface of zero potential must momentarily turn through a right angle, and then jump back again as the loop snaps off. I cannot, by any stretch of imagination, find a physical cause for so curious a gymnastic feat. As already pointed out, Mr. Vreeland regards the loop as thrown off *before* the ends of the lines of electric strain meet; Dr. Fleming thinks it is detached *after* they have crossed. I incline to the opinion that if any such loops be formed at all (as to which I reserve judgment), it is at the moment when they meet in the spark gap. This implies that the ends of each line of force pass along the conductor, making with it an angle continually smaller and smaller, and at last vanishing altogether (fig. 2). In this way the geometrical

Fig. 2.

difficulties may be overcome, but certain physical questions remain unanswered. It is, perhaps, hypercritical to note that the height of Dr. Fleming's loops is the same throughout the process of closing. This implies that, except in the immediate neighbourhood of the gap, the electric field remains unchanged throughout the meridian of the field until the closing of the first loop; an inference which I am sure Dr. Fleming would be the first to repudiate.

I have dwelt somewhat at length on the discrepancies and vagueness in treating this theory of closed loops, since it may be some justification for reopening the question. Were all authorities of one tale, it might be better to bottle up one's doubts, to attribute one's difficulties to imperfect understanding; but in face of these discrepancies it may not be presumptuous to ask for explanation, or even to hint at some scepticism. Apart from the contradictions above mentioned, there is a lack of any satisfactory explanation why these loops should go off at the speed of light, or at any other speed. One would naturally expect a closed line of force merely to contract by its own tension and go out, like the flame of a candle. In so doing it might set up electro-magnetic disturbances which would give rise to a wave, but that would be quite another story from the forcing outwards, the repulsions, pushings and flattenings of the authors I have quoted. Such notions, whether well or ill-founded, are entirely foreign to the idea of wave motion, a point of some importance when it is considered how closely the subject of Hertzian waves is linked with the undulatory theory of light.

We are asked to believe, and most people who have considered the subject do believe, that radiant light consists of electro-magnetic waves of exceedingly small wave lengths, proceeding from bodies analogous to Hertzian oscillators of atomic dimensions, oriented in every direction. At first sight Prof. Fleming's picture of a succession of Rugby footballs kicked into space is much more suggestive of a corpuscular than of an undulatory theory. A little consideration modifies this first impression. The drawing is in section, and the solid figure is obtained by the revolution of the section about the oscillator. Consequently the loops are not sections of footballs, but of bicycle tires, which, as they expand outward, also expand laterally and become more and more deflated, folding inwards on the inner side. This is a queer sort of corpuscle, but a number of them all in a tangle constitutes a still queerer representation of a wave front.

The Natural History of Lines of Force.

Seeing that an electric wave, *aliter*, a closed line of electric strain (or rather a pair of such lines) was directly derived from a line of force, though as different from it in function and habit as a butterfly from a caterpillar, I thought it worth while to consider more particularly the nature of lines of force, in the hope that I might thereby clear up my bewilderment. In indicating what seems to me to be the way out, I shall have to go over some rather elementary ground, but I will try to avoid being tedious.

In the days when action at a distance was a credible hypothesis (only astronomers believe in it now, and they only tentatively and with many apologies) the electric potential at any point was expressed by $\Sigma \frac{Q}{r}$, where Q_1, Q_2, &c., were charges positive or negative at distances r_1, r_2, &c., from the point, and the equation $\Sigma \frac{Q}{r} = A$ was the equation to an equi-potential surface. By varying A, a family of equi-potential surfaces could be obtained, and lines of force were lines in space which cut the whole series normally. In particular cases, as when there are but two charges equal in amount and opposite in sign, the surfaces and lines can be calculated and plotted. If the charges are on the surfaces of conductors, those surfaces are themselves equi-potential surfaces, and if they be of the same size and shape, the configuration of the surfaces and the position of the lines are not altered by a transfer of charge from one of the conductors to the other.* The difference of potential is changed, but if the successive surfaces be labelled as successive fractions of that difference, they remain in position (except for a small momentary disturbance during the transfer). The field also is weakened or strengthened, but its configuration is the same. Of course, if the surfaces be labelled with their absolute values, say from 100 volts to −100 volts, and then the difference of potential be dropped by one-half, all the surfaces above 50 volts or below −50 will collapse on to the conductors, and other will move outwards to take their place, the zero plane alone remaining stationary. But even then it is not necessary to predicate any movement of the lines of force. The direction of the force at any point remains unchanged, its magnitude only has altered.

Nor does the introduction of the idea of a medium in which there are stresses and strains along, and perpendicular to, the lines imply change in their position. It is quite possible to imagine the relaxation of a strain without any other than molecular movement being implied, that movement taking place at the point where the strain is relaxed. The notion of the sideway motion of lines of force is a convention following on the giving of each line (or tube) of force a value in terms of which the stresses are measured, and the assumption that each line is continuous and indestructible, save by its collapse to molecular dimensions. If we assume that the force, or displacement, at a point is measured in terms of the number of lines per square centimetre at that point, it is evident that the number of lines must be diminished or increased if the stress or strain is to be changed, and the only way in which their continuity can be preserved, and they can remain lines of force, is by a sideway motion into and out of the space surrounding the point. There will be a flux into as well as out of the space, and the difference registers the change. The lines and the motion of the lines serve as a calculating mechanism, they are exceedingly convenient for this purpose and facilitate the construction of differential equations closely allied to those which occur in hydrodynamics (and it is always pleasant to find half your work done in advance); but for the physical changes that are taking place one must look not to the moving lines but to the spaces they are crowding and vacating. Your bank book tells you all about your balance at the bank and its fluctuations, but the burglar who steals the book does not acquire control over the account.

If in ordinary mechanics we adopt the same methods we shall arrive at similar results. The tension of a rope, the stresses in a bow and bowstring,* or those in a fly-wheel might all be expressed in terms of pounds per sq. in. of section, and have directions varying in some of these cases from point to point. These might be represented by lines of force of density varying from place to place, and any change in time, such as a slackening of the rope, a speeding up of the fly-wheel, could be expressed in terms of a sideway flux of lines of force. When a fly-wheel bursts I suppose these lines of force shrink into the shaft, but no one cares what becomes of them. The mischief is done by the masses of iron they have abandoned. Similarly, when a spark discharges a Hertzian oscillator I suggest that we look for the origin of the electric wave, not in the collapsing lines of force, but in the strained ether suddenly released.

Before I come to that, however, I wish to guard against a misconception. It may be that in emphasising the calculus function of lines of force I appear to ignore too much their objective reality. I shall be told that each stands on a definite charge $\frac{1}{4\pi}$th of a unit charge, and ends in an equal negative charge (a few years ago this would have been put that a charge *was* the end of a line of force, but now it is a group of electrons); that it has a tension all along it, and is subject to pressure, so that its motion is not a mere register of changes, like a shifting line of light on a sheet of tin under distortion, but is rather that of a material body pushed and pulled about by forces. As to this latter point I prefer an agnostic attitude. If the lines of force have mass their dynamics constitute an exceedingly difficult problem. If they have no mass then any force applied to them will generate an infinite velocity in any finite time, however short. On the whole, I incline to the opinion that these tensions and pressures should be regarded as static, especially when their historical origin is taken into account. When first action at a distance was repudiated, it became necessary to endow the lines of force with tension to account for the elementary fact that oppositely charged bodies attract one another. But a curved elastic line under tension would obviously contract until it became straight unless the pressure on its two sides were unequal. Action at a distance was deposed, or dead, but its laws, founded on experiment and calculation, were still on the statute book, and these required moved lines of force. Therefore it became necessary to invent a pressure or repulsion between the lines. It is curious how little one hears of this pressure once it has served that purpose.

Whether the motion of lines of force be itself an objective reality, or whether it be only a convention representing real physical changes, there is no question of the utility of this method of representation. Not only does it enable us to put the theory on a mathematical basis, but, even in its simpler opsigraphic form, it helps us to realise that electric energy travels mainly through the dielectric, that a conductor is merely a guide, and that a current must needs start on the exterior surface of a conductor. It is a good exercise, but not always a very easy one, to picture some familiar electric process in terms of the march of lines of force. Take, for instance, the setting up of the electric field around a

* Save in so far as the amount of the charge may slightly modify its distribution on the conductors.

* It is a pity that mathematical physics were unknown in the middle ages. I like to picture a meeting of the Royal Toxophilite Institution gravely discussing the flux of lines of force in a drawn bow when released, and the proportion of energy carried away with the arrow to that expended uselessly in heating the bow and fraying the string; or devising bows of impossible cross section and design, to facilitate mathematical calculation—until interrupted by an incursion of Robin Hood and his merry men, with practical illustrations.

Hertz oscillator from the moment of closing the primary circuit to just before the spark. Most people will be quite content to begin at the terminals of the secondary coil.

Electric Displacement and Displacement Currents.

When a material elastic body is slightly distorted, the displacement at any point is generally proportional to the distorting stress; and if the constraint be suddenly removed, the body will vibrate about its position of equilibrium, and gradually come to rest. In the simpler cases, such as that of a pendulum or of a piece of watch-spring, the vibrations are isochronous, but where the strain is complex, and the elasticity of the body different in different directions, vibrations of many (and changing) periodicities may occur. The displacement is also in the direction of the stress as well as proportional to it, and of the same kind—a twist in consequence of a torque, elongation produced by tension, and so forth. By analogy, we should suppose the electric displacement at any point in a dielectric to be a displacement of something, presumably an element of electric charge, in the direction of the line of force and through a distance proportional to the electric force at that point. Of course, it might be a twist about the line of force or any other sort of strain, such as the angular displacement of a polarised molecule, if the electric force be supposed to be a corresponding stress, but essentially the meaning of the word is the same in electric as in mechanical science.

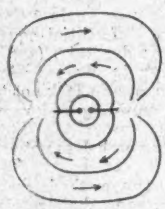


Fig. 3.

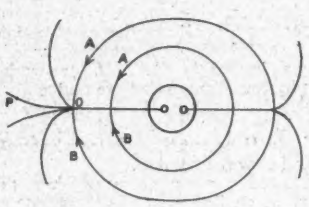


Fig. 4.

This meaning is, however, very carefully disguised in the text books:—

> What Maxwell called the electric displacement in any direction at a point is the number of Faraday tubes which pass through a unit area through the point drawn at right-angles to that direction, the number being reckoned algebraically . . . .

That is from Prof. J. J. Thomson's "Electricity and Matter," and it is followed by an explanation of what reckoning algebraically means. It is a very accurate and complete definition, and it leaves the student wondering how on earth a number of lines came to be called a displacement. The professor himself seems to sympathise with this feeling, for he goes on to say:—

> For my own part, I have found the conception of Faraday tubes to lend itself much more readily to the formation of a mental picture of the processes going on in an electric field than that of electric displacement, and have for many years abandoned the latter method.

I read that sentence with the greatest satisfaction: it is always a pleasure to find some sign of human weakness in those whom we are accustomed to regard as the leaders of scientific thought. But the definition is in reality only troublesome, because it tries to cover too much. It would be difficult to find a unit area in any practical case traversed by lines in two opposite directions, and no one wants, as a rule, to know the displacement *in any direction*, but the actual displacement. So the definition gets narrowed down to "the density of the Faraday tubes at that point," and since the professor tells us that this is a measure of the tension of each tube, which tension, in turn, is equal to the intensity of the electric force, we get back to the mechanical idea of a displacement proportional to the force producing it, and can leave the tubes for the present out of account.

Electric Waves.

Now let us consider what takes place when a Hertzian oscillator is being charged. As the potential difference between its antennæ rises, the space surrounding the oscillator is subject to electric strain, and along the lines of electric strain displacement currents flow.

For the moment, to fix our ideas, suppose the displacement to be one of electric charges (or of electrons, if preferred) entangled in an elastic medium. The currents depend on the quantity of electricity in motion and on its velocity. Both these being small, the currents are insignificant, as also are the magnetic fields associated with them. But when discharge occurs the strain is relaxed with a rush. In a period of time compared with which a microsecond is tedious, these electric charges have rushed back to their position of equilibrium, and the *replacement* currents are large in spite of the smallness of the charges. Associated with these currents there spring up in every part of the field magnetic whirls, which blend together and flash out into the undisturbed ether lying beyond it. Flash out at an extremely rapid rate, and therefore produce violent electric stresses and displacement currents therein in the opposite direction. These in turn generate magnetic fields which flash out into the next space, and so on, each excursion and retreat of the magnetic field passing on the electric stress and resulting current half a wave length (fig. 3). The resultant magnetic fields are annular, with the oscillator as axis, and their direction is reversed every half wave length. There is a magnetic field also due to the current in the oscillator itself, the direction of which is always opposed to that due to the displacement currents in the electrostatic field. Hence there is a further reason why rapid oscillation is necessary to the generation of electric waves; for were the oscillations slow, say, 1,000 per second, not only would the displacement currents be small, but the neighbouring ether would be subject to the opposing force of the oscillator field before its displacement current could rise to any appreciable value. It would be like a mirror galvanometer subject to an alternating E.M.F. and would not move at all.

It here becomes necessary to explain how it is that there is no wave propagated in the direction of the conductors, since there must needs be displacement currents along those portions of the lines of force which are nearly perpendicular to the conductors.

Consider a point P lying near the axis and a little beyond the end of one of the antennæ (fig. 4). The inductive effect of currents such as A, A on it would be to produce a displacement nearly perpendicular to the axis and away from it: That of B, B would also be nearly perpendicular, would be somewhat less and be in the opposite direction. There must also be taken into account the current due to the displacement in the line through P, and the induction from similar neighbouring lines converging to a cusp at the end O of the antenna. These currents, however, are very small, and the displacement due to them, such as it is, opposes the displacement current through P. Exact calculation is not possible without a knowledge of the form and strength at each point of the electric field, and of the rate at which the magnetic field extends outward, but without any calculation it is clear that the forces at P very nearly cancel one another, and the resultant current is consequently small. The argument holds similarly for all points near the axis, and the effect is cumulative. For if the displacement currents induced are small, their magnetic fields will in turn be weak; but such as they are they interfere with one another at the next step outwards, so that in a few waves' length at the most there will be no perceptible radiation over a considerable angular space from the ends of the antennæ. It might be worth while to try whether by intercepting the wave due to B, B by a shield, or turning it away by a prism, radiation could not be obtained along the axis. The prism would be preferable since the presence of a metallic shield would seriously distort the electric field of the oscillator.

It does not follow that the angular space through which the wave quickly dies away is altogether free from electric wave disturbance. The length of the wave is great, and, therefore, there is considerable diffraction. Were the wave front spherical and the intensity equal in all directions, this would not affect the distribution of the wave energy, but as the intensity falls off rapidly as we recede from the plane perpendicular to the air gap the wave front tends to spread laterally, and the wings to approach one another until their distance is again comparable with a wave length, when interference comes into play once more. The bending back of the alleged "lines of electric strain" in their cake-walk across the Atlantic, as depicted in the text-books, really represents this effect of diffraction.

Here, perhaps, we have the germ of the idea of those travelling closed lines of electric strain. If the wave were spherical and equally intense in all directions, there would be at half waves length distance throughout a series of waves, nodal spheres where the displacement currents would be zero and the electric strain a maximum. The section of these spheres by a plane through the oscillator would be circles (fig. 5).

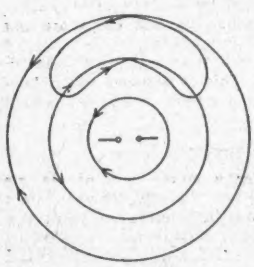


Fig. 5.

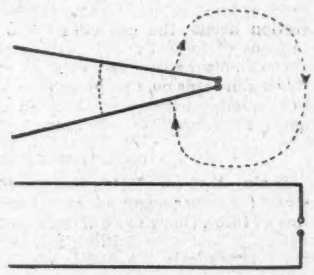


Fig. 6.

But, owing to diffraction, the propagation is not rectilinear except along the plane perpendicular to the oscillator through the spark gap; the wave surface is not spherical, and it is possible that the front of one line of maximum strain turning over so as to intersect the following one might give rise to the notion of a closed line of force, and since the nodal surfaces must needs move with the speed of the wave, the machinery is provided for the "repulsion" of the loops with the speed of light.

In conclusion, the points which I wish to emphasise are:—

1. That there is no evidence of any "decussation," "snapping off," or "nipping off" of the collapsing lines of force; nor of their crossing one another.

2. That the collapse is a mathematical fiction convenient for purposes of calculation; and that to associate the ideas of inertia and energy with it is like talking of the inertia of a column of figures or the toughness of a differential equation.

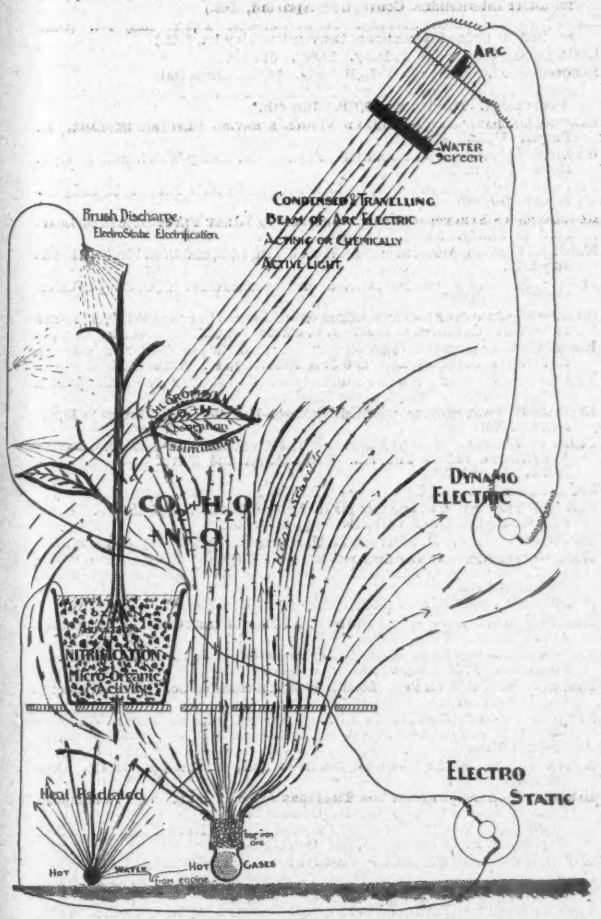
3. That the origin of an electric wave is the relaxation of the strain in the ether around the oscillator. Too much importance is attached to the current in the oscillator itself, the function of which is to build up the electrostatic field. The study of the form of the field is probably the true clue to the devising of means for directed wave propagation. The explanation given by Dr. Fleming of the effect of using antennæ inclined at an acute angle, or parallel to one another (fig. 6), which practically comes to saying that this arrangement gives the collapsing loop a better take

off for its jump into space, seems to me quite inadequate. Moreover, it ignores the whole electrostatic field except that infinitesimal part which lies in the plane of the antennæ.

ELECTRIC CULTURE.

On Friday last Mr. B. H. Thwaite read a paper before the Royal Botanic Society, describing the new experimental installation which he has carried out at the Royal Botanic Gardens, Regent's Park. The author divided the early workers on this subject into those who utilised the effects of the arc light on the leaves of plants, and those who applied electrostatic stimuli to the plant and to the roots and stalks, in association with solar light; he then briefly summarised the results of their investigations, and explained the function of chlorophyll in the transformation of inorganic matter into organic products under the influence of light of suitable quality.

"Whilst it may be broadly suggested that lunar and earth electric currents appear to energise in the direction of restoring minerals back from their organic state or association to their mineral state, solar electric energy appears to be directed to the



Diagrammatical Representation of Mr. Tewaite's System of Electric Culture.

conversion of minerals into constituent elements, making up organic compounds necessary for the generation or creation of organic (animal and vegetable) activity summarised by the expression *Life*."

After further discussing the biological phenomena which characterise plant growth, Mr. Thwaite concludes that "if a near imitation of natural forces is to be secured for the artificial cultivation of plants and independently of the sun or weather, the following agents must be assembled and harnessed for the common object:—

"A.—An ample supply of violet or chemically active rays projected from powerful arc lights.

"B.—A supply of electrostatic current for atmospheric and root electrification.

"C.—The plant environment of an atmosphere containing moisture and CO_2 in the proportions common to the most fertile countries, and at temperatures within the limits of 76° F. and 80° F.

"D.—An ideal fertilising agent.

"E.—An ample supply of water for the roots."

The system of electric culture about to be put to a practical test is designed to produce the condition specified, on a sufficiently large scale. The necessary heat and actinic light, as well as the carbon dioxide, moisture and nitrogen fertiliser in the form of ammonia sulphate, are to be derived from coal; "on the perfection of the combustion of the coal or fuel used depends the entire economy of the system," and this perfection can only be secured by converting the carbon into a gaseous condition.

These conditions are fulfilled by the employment of a suction gas producer and gas engine, whereby perfect combustion is attained simultaneously with the development of power, which is converted into electrical energy. The heat absorbed by the cooling water in the cylinder jacket is utilised for the purpose of heating the air in the glass house by means of circulating pipes, and the heat carried off in the exhaust gases is similarly employed by leading them, after purification, through earthenware junction pipes into the glass house, with outlets at suitable points, so that, at the same time, carbon dioxide, water vapour, oxygen and nitrogen are supplied in a heated condition to the plants, with suitable regulating devices at the points of outlet or discharge.

The author divides the heat energy of the coal as follows: 30 per cent. to power production, 30 per cent. to jacket water, and 30 per cent. to waste gases for heating purposes, the balance of 10 per cent. being absorbed in generating the gas and in dissociating the water introduced into the producer into hydrogen and oxygen, which afterwards recombine and pass with the exhaust gases into the glass house as moisture. The gases are desulphurised, both before and after combustion, with bog-iron ore. The electrical energy generated is used for feeding the arc lights. An electrostatic machine driven from the gas engine shaft supplies energy which is discharged by points located along the plants, the object being the electrification, not only of the air of the glass house, but of the plants and their roots as well.

The power and heat developed and the proportion of moisture are easily controlled. The arc lights are equipped with special reflector hoods, confining the beam of light within narrow limits of concentration; the open end of the hood is closed in with a water screen, to secure as near an imitation of natural solar effect as possible, and to limit the effect of the ultra-red rays. The water can be coloured if desired. The hood is provided with a chimney to carry off the nitrous oxides that may be produced. The arc lights are constantly and almost imperceptibly moved to and fro along the entire length of the glass house by an electrical traveller.

The installation will permit a wide range of experiments to be made, with a view to determining the conditions to secure the maximum degree of acceleration of plant growth with the most perfect quality and augmentation of weight of the products. The power of producing fruit at any period of the year was successfully attained by Sir William Siemens with a comparatively primitive installation, and the triple combination of water-screened arc light, electrostatic stimulus and highly fertilising atmosphere will, it is hoped, secure still better results. Whether the application of electric culture will be extended to field work is a question for the future.

Heating with Exhaust Steam.—A frequently recurring subject of interest in American papers is that of methods of heating offices and buildings. Present English climatic conditions almost justify a reference to the matter. A paper recently read before the Ohio Society of Mechanical, Electrical and Steam Engineers, by Mr. F. W. Ballard, entitled "Steam Power *v.* Gas Power," deals entirely with the advantages to the steam engine from using exhaust steam heating. In those parts of the paper where the author deals exclusively with the facts of steam heating, he is on safe ground, and puts forward some interesting details which apply, so far as English conditions are concerned, to factories and offices where steam power is used.

"I find in practice that, on an average, when a full head of exhaust steam is maintained upon the radiators, about 250 heat units are radiated per hour per sq. ft. of radiation. This amount is approximately correct as per Carpenter's tables, when the difference between the temperature of the radiator and the air in the room is 150°. According to the same authority, the amount of steam condensed per hour per sq ft. of radiation would be about 0·25 lb., or, in other words, 1 lb. of steam would supply 4 sq. ft. of radiation.

"I find in practice, however, that in using exhaust steam, 1 lb. will supply only about 3 sq. ft. of radiation. Assuming this amount to be correct, and that the engines in the power plant will consume 30 lb. of steam per H.P.-hour, then 1-H.P. capacity in the power plant would furnish exhaust steam enough to heat 450 sq. ft. of offices, 600 sq. ft. in the factory, and 900 sq. ft. in the warehouse."

The sections of the paper presumed to be comparative are deficient in detail, partly because the author is content to quote prices for coal and natural gas only of high thermal value, and does not consider producer gas; and partly because no actual figures derived from practical working are put forward. As the author indicates, the best solution would consist in passing part of the heated circulation water from the jackets through a tubular heater, heated by the exhaust gases. The emphasis which Mr. Ballard places upon heating as an adjunct to the power plant is justifiable in countries possessing protracted periods of intense cold, or in manufacturing operations in which large volumes of liquid have to be heated to about 200° F. Otherwise heating of premises is a mere incident, and the first concern of the manufacturer is cheap power.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

1,197A. "Improvements in and relating to the treatment of refractory materials by electricity." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) (Date applied for under Rule 5 of the Patents Rules, 1905, January 16th, 1907.) July 17th.

16,189. "Improvements in fixing the terminals and contact-pieces of electrical fittings." H. Bevis and F. M. Chapman. July 15th.

16,191. "New or improved automatic electro-magnetic switch or cut-out for disconnecting charged conductors in overhead systems of electric traction or the like." W. Barraclough. July 15th.

16,227. "Means for controlling the supply of electricity at a distance." W. Corin. July 15th.

16,235. "Improvements in and relating to electric light and bell fittings." H. V. Pears. July 15th.

16,251. "Improvements in insulating conduits for electric wires." A. P. Hinsky. July 15th. (Complete.)

16,263. "Electric switch-operating device." P. Rojchik. July 15th. (Complete.)

16,268. "Earphone." A. J. Hulk. July 16th.

16,272. "Safety attachment for the raising of sunken submarines to the surface and telephoning thereto." B. Hilling. July 16th.

16,286. "Improvements in or relating to signals on electric and other vehicles for the prevention of accidents to passengers or pedestrians." C. J. Sutton and J. Rudd. July 16th.

16,301. "New form of electric lamp for lighthouse apparatus." C. A. Stevenson. July 16th. (Complete.)

16,327. "Improvements in electro-pneumatic track channelers." H. W. Lake. (Ingersol-Rand Co., United States.) July 16th. (Complete.)

16,334. "Improvements in printing telegraphs." Siemens Bros. & Co., Ltd., and G. S. Grimston. July 16th.

16,346. "Improvements in electrical systems of distribution." W. A. Turbayne. (Date applied for under Patents Act, 1901, July 25th, 1906, being date of application in United States.) July 16th. (Complete.)

16,360. "Improvements in and relating to electric batteries." H. De Martis and H. O. Thomas. July 16th.

16,364. "Improvements in automatic multiple fuse blocks." W. C. Mayo and J. Houlehan. July 16th.

16,366. "Improvements in starters for electric motors." W. C. Mayo and J. Houlehan. (Date applied for under Patents Act, 1901, February 11th, 1907, being date of application in United States.) July 16th. (Complete.)

16,369. "Improvements in electric switches." S. O. Cowper-Coles. July 16th.

16,372. "Improved method of and means for applying insulating material to electric cables, parts of electric generators or motors and the like." H. McPhail. July 16th.

16,383. "Improvements in electric light carriers or fittings." H. M. Appleyard and E. Quiggin. July 17th.

16,386. "Improvement in starting switches for electrical motors." F. J. A. Matthews. July 17th.

16,393. "New or improved appliance for electrical or mechanical massage." J. C. M. Moore. July 17th.

16,404. "Improvements in or relating to electric contact-breakers, particularly for use with internal combustion engines." J. Milburn. July 17th.

16,402. "Improvements in telephonic transmitters and translators." W. J. Ricketts. July 17th.

16,431. "Improvements in connection with incandescence electric lamps." C. H. Stearn and C F. Topham. July 17th.

16,450. "Improvements in electric motor control." F. A. Petch, F. Duncan and O. C. F. King. July 18th.

16,461. "Improvements in or connected with devices for making and breaking electric contacts." F. H. Varley. July 18th.

16,481. "Improvements in oscillographs." J. T. Irwin. July 18th.

16,485. "Improvements relating to appliances for regulating or controlling and measuring electric currents." R. Lenner. July 18th.

16,500. "Improvements relating to electric self-winding clocks." W. E. Lake. (C. E. Sanford, United States.) July 18th. (Complete.)

16,503. "Improved method of attaching tungsten filaments in electric glow lamps." Deutsche Gasglulhlicht Akt.-Ges. (Auerges). (Date applied for under Patents Act, 1901, May 6th, 1907, being date of application in Germany). July 18th. (Complete.)

16,508. "Improvements relating to mouthpieces for telephones, speaking tubes and the like." G. W. Becheraz. July 18th.

16,513. "Apparatus for cooling electric machinery." W. L. Wise. (C. O. Mailloux, U.S.) July 18th. (Complete.)

16,529. "Improvements in and relating to alternating-current electric motor of the commutator type." Allgemeine Elektricitats Ges. (Date applied for under Patents Act, 1901, July 19th, 1906, being date of application in Germany.) July 18th. (Complete).

16,531. "Improvements in and relating to supports for the filaments of electric incandescent lamps." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) July 18th.

16,536. "Improved form of telephone or other message recorder." E. E. Moore and W. Powles. July 19th.

16,548. "Improvements relating to electrical testing apparatus." C. T. Gambrell and T. E. Gambrell. July 19th.

16,559. "Improvements in electrically-driven tire inflaters." C. R. Whipple. July 19th.

16,571. "Improvements in electrical measuring instruments." O. D. Lucas. July 19th.

16,574. "Improvements in electrical switches." A. P. Lundberg, G. C. Lundberg and P. A. Lundberg. July 19th. (Complete.)

16,577. "Improvements in fittings for supporting electric conductors." T. Buchholz. July 19th. (Complete.)

16,582. "Improvement in controlling switches for electric trains." Siemens Schuckert-Werke G.m.b.H. (Date applied for under Patents Act, 1901, July 28th, 1906, being date of application in Germany.) July 19th. (Complete.)

16,585. "Improvements in electric clock systems." A. R. Upward. July 19th.

16,586. "Improvements in or connected with washers and terminals or the like for electrical work." G. H. Bartlett. July 19th.

16,600. "Improved electrically propelled vehicle." H. F. Schreiber. July 19th.

16,615. "Improvements in and relating to protective devices for electric distribution systems." British Thomson-Houston Co., Ltd., E. B. Wedmore, and W. P. Hamlyn. July 19th.

16,616. "Improvements in and relating to filaments for electric lamps." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) July 19th.

16,617. "Improvements in and relating to filaments for electric lamps." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) July 19th.

16,618. "Improvements in and relating to transformers and controlling apparatus therefor." Allgemeine Elektricitats Ges. (Date applied for under Patents Act, 1901, July 19th, 1906, being date of application in Germany.) July 19th. (Complete.)

16,640. "Method of obtaining power from running cable for compressing air for compressed-air motors fitted to tramway cars." A. H. Black. July 20th.

16,642. "Electrical device for the automatic control of time signals of electric light circuits." F. C. Webber. July 20th.

16,644. "Improvements in electrical devices for exhibiting advertisements." C. C. Hewett, R. T. Smith and W. F. Foster. July 20th.

16,675. "Improved magnetic ore separator." G. W. Lundberg and A. G. Holmberg. July 20th. (Complete.)

16,680. "Improvements in apparatus for conveying sound and the like." F. G. Barnes and H. C. Braun. July 20th.

16,696. "Improvements in or relating to electrically heated apparatus suitable for cooking and other purposes." A. F. Berry. July 20th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1906.

Dynamo-Electric Machines. J. Y. Johnson. (Felten & Guilleaume Lahmeyerwerke Akt.-Ges.) 7,920. April 2nd.

Continuous Electrolysis. G. Rambaldini. 8,089. April 3rd. (Date applied for under International Convention, April 3rd, 1905.)

Party-Line Telephone Systems. H. J. Roberts. 10,218. May 1st. (Date applied for under International Convention, May 1st, 1905.)

Electric Arc Lamps. W. J. Davy. 14,809. June 28th.

Electrolytic Diaphragms. I. L. Roberts. 14,922. June 30th.

Electrical Connections of Motor Road Vehicles having Electro-Mechanical Propulsion. H. Pieper. 15,178. July 4th.

Electro-Mechanically Propelled Vehicles having Electric Storage. H. Pieper. 15,180. July 4th.

Ignition of Internal Combustion Engines. M. Kemp-Welch and P. Lyle. 15,412. July 6th.

Electric Vulcanising Apparatus. L. Binko and Phœnix Electric Heating Co. 15,499. July 9th.

Regulation of Electric Currents Subject to Large Fluctuations of Load. M. J. E. Tilney. 15,988. July 14th.

Magnetic Control Appliances. Stothert & Pitt, Ltd., and C. R. Heath. 16,342. July 19th.

Process for the Rapid Production of Electrotypes. S. O. Cowper-Coles. 17,617. August 4th.

Ignition Mechanism of Internal Combustion Motors, Particularly Applicable to Motors for Motor Cycles. J. C. Owers. 17,884. August 9th.

Rotary Bar Electrical Ignition for Internal Combustion Engines. G. Anderson & Co. (1905), Ltd., and J. A. Ross. 17,946. August 10th.

Means for the Regulation of Electrical Machines. J. Y. Johnson. (Felten and Guilleaume Lahmeyerwerke Akt.-Ges.) 18,156. August 13th.

Electric Railway Systems. British Thomson-Houston Co. (Kintner.) 18,279 August 14th.

Cores of Dynamo-Electric Machines, Transformers and the like, having Ventilating Spaces Therein. H. H. Mavor and Mavor & Coulson, Ltd. 18,343. August 15th.

Electric Switches for Telephones. K. Weman. 18,889. August 23rd.

Electric Transformers and the like. British Thomson-Houston Co. (General Electric Co., U.S.A.) 20,395. September 13th.

Electric Switches. H. Hirst and H. T. Harrison. 21,053. September 22nd.

Wall Connections and the like for Electric Lighting, Heating and Power Purposes. A. P. Lundberg, G. C. Lundberg and P. A. Lundberg. 21,391. September 27th.

Electrical Cells. E. Gersabeck. 22,189. October 6th.

Magnetising the Edge of the Blade of a Razor or Like Cutting Instrument. J. B. Hilliard. 22,155. October 8th.

Ventilation of the Cores of Dynamos, Transformers and other Electrical Machines. P. A. Lange. 22,497. October 11th.

Dynamo-Electric Machines. British Thomson-Houston Co. (General Electric Co., U.S.A.) 22,625. October 12th.

Electric Current Collecting Devices for Railway or other Vehicles. British Thomson-Houston Co. (General Electric Co., U.S.A.) 22,795. October 15th.

Active Materials for Electric Accumulators. H. Leitner. 23,413. October 22nd.

Electric Lighting Devices for Theatres and the like. W. P. Thompson (Firm of Schwabe & Co.) 23,427. October 22nd.

Electric Vent Sealing Tubes or Primers. King's Norton Metal Co., T. A. Bayliss and H. M. Smith. 24,270. October 31st.

Mariners' Compasses. L. W. P. Chetwynd. 25,965. November 16th.

Control of the Ignition in Internal Combustion Engines. A. Jack. 26,154 November 19th.

Ignition Gear for Internal Combustion Engines. L. R. L. Squire. 27,835. December 6th.

Electric Arc Lamps. H. J. J. Jaburg. 29,394. December 24th.

1907.

Electric Induction Furnaces. Soc. des Procedes Gin Pour la Metallurgie Electrique. 1,080. January 15th. (Date applied for under International Convention, March 7th, 1906.)

Device for Igniting a Gas or Gaseous Mixture by means of Electric Sparks. E. C. R. Marks. (Akt.-Ges. für Automatische Zund und Losch Apparate.) 1,201. January 16th.

Starting and Regulation of Electric Motors. Siemens-Schuckertwerke Ges. 1,243. January 17th. (Date applied for under International Convention, February 3rd, 1906.)

Thermal Electric Contact-Making Devices. F. W. Francombe. 2,106. January 23th.

Crowns or Covers of Electric Furnaces. R. B. Ransford. (Soc. Anon. Electrometallurgique procédes Paul Girod). 3,776. February 9th.

Electric Wave Meters. S. Eisenstein. 3,983. February 15th.

Electrode for Sparking Plugs. J. Aldigier. 4,667. February 26th.

Electric Transformer Furnaces. E. A. A. Gronwall, A. R. Lindblad and O. Stalhane. 6,193. March 14th.

Armatures of Magneto-Electric and like Machines. K. Glossel and L. Littmann. 7,809. March 27th.

Pocket Magnetic Compasses. S. S. Lawrence. 10,522. May 6th.